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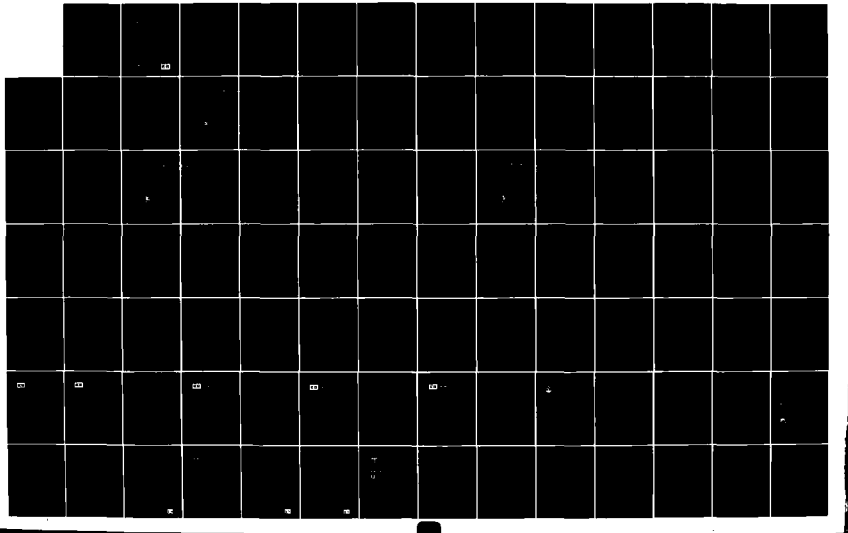

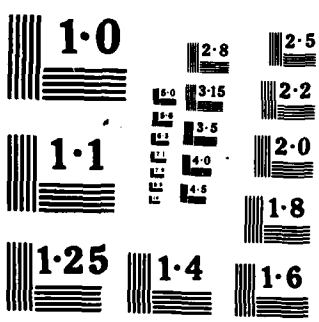
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FINAL REPORT INSTALLATION RESTORATION PROGRAM

PHASE II, STAGE 2 - SURVEY

EDWARDS AFB, CALIFORNIA

PREPARED FOR

U S AIR FORCE
OCCUPATIONAL AND ENVIRONMENTAL HEALTH LABORATORY
BROOKS AFB, TEXAS

AUGUST 1984

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19. ABSTRACT (Continue on reverse if necessary and identify by block number)

A Phase II Stage 2 evaluation was conducted at Edwards AFB CA under the Installation Restoration Program (IRP). Nine sites were investigated during this study to further define the magnitude and extent of contamination. This study involved the installation of lysimeters, groundwater monitoring wells and soil borings; samples of groundwater and soil were analyzed for several potential contaminants. The study concluded that groundwater is not contaminated at Sites 1A, 1B, 1C, 1D1 and 1D2. Limited soil contamination exists at Sites 1C and 1D1. Site 8 has soil contamination but no significant groundwater contamination. Extent of contamination at Site 5 is unclear, and further monitoring is recommended. The lysimeters at Sites 2 and 3 should also be monitored on a regular basis.

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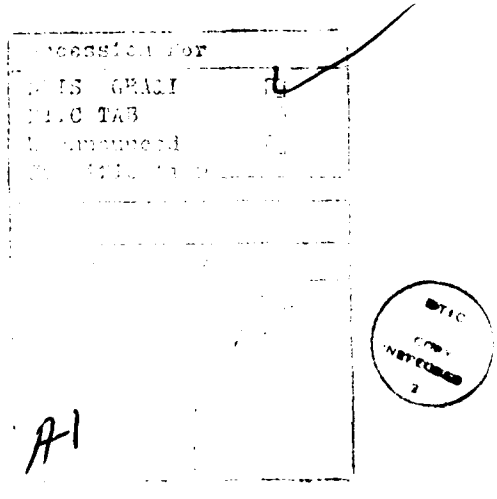
This report has been prepared for the United States Air Force by Engineering-Science for the purpose of aiding in the implementation of the Air Force Installation Restoration Program. It is not an endorsement of any product. The views expressed herein are those of the contractor and do not necessarily reflect the official views of the United States Air Force or the Department of Defense.



FINAL REPORT
INSTALLATION RESTORATION PROGRAM
PHASE II - STAGE 2 - SURVEY
EDWARDS AFB, CALIFORNIA

Prepared for

UNITED STATES AIR FORCE
OCCUPATIONAL AND ENVIRONMENTAL
HEALTH LABORATORY
BROOKS AFB, TEXAS

August 1984

Prepared by

ENGINEERING-SCIENCE
125 West Huntington Drive
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TABLE OF CONTENTS

TABLE OF CONTENTS
(continued)

LIST OF TABLES

LIST OF FIGURES

EXECUTIVE SUMMARY

EXECUTIVE SUMMARY

Engineering-Science, Inc. performed explorations and studies which resulted in a report entitled Installation Restoration Program, Phase II - Confirmation, Edwards AFB, California. This report was submitted in September 1982. As a result of the findings of that report, ES was asked to perform further explorations and studies. This report presents the results of the supplementary work performed.

SCOPE

The supplemetary program, Stage 2, consisted of the following:

- Installation of a monitoring well down gradient of Sites 1A, 1B, 1C, 1D1, and 1D2. Analyses of soil samples taken during construction of that well and initial analyses of water samples from the monitoring well.
- Installation of three shallow borings located radially from Site 1D1 to determine the extent of gaseous contamination of soils.
- Installation of one lysimeter each at the periphery of Sites 2 and 3.
- Locating and sampling for fuel at existing Well No. 9N/9W-6C1 (MB-1) near Site 5.
- Redevelopment of existing well 9N/9W-6E1 and sampling for fuel.
- Installation of two monitoring wells down gradient from the POL (petroleum, oil, and lubricants) tanks at Site 5 and analysis of initial samples taken from that well.
- Installation of one monitoring well down gradient from the industrial waste pond, Site 8. Analysis of initial samples taken from that well.

- Background soil sample taken about two miles to the north and east of the principal area of Base activities and analyzed for metals, residual pesticides, and polychlorinated biphenyls (PCB).

FINDINGS

North Base (Sites 1A, 1B, 1C, 1D1, 1D2)

- A monitoring well has been installed at the site (Well 12).
- At the time of this work, groundwater samples showed no significant contamination.
- Nitrate contamination due to disposal of nitric acid wastes seems to be limited to the disposal pit and the soils below the surface. No horizontal migration of nitrate was observed at Well 12, approximately 60 feet from the acid pit.
- Gaseous migration of chloroform and trichlorofluoromethane is limited to a radius of less than 200 feet from disposal trench 1D.

Main Base (Site 8)

- A monitoring well has been installed at Site 8 (Well 15).
- At the time of this work, no significant contamination of the groundwater was observed.
- Soil samples taken while drilling Well 15 indicated relatively high levels of chromium, arsenic, lead, and selenium. These limits were not so high as to produce an imminent health hazard; however, they were slightly high as related to California Assessment Manual criteria for soils. It must be noted, however, that a background soil sample taken at another part of the Base was similarly high in chromium, arsenic and selenium; thus these findings may simply reflect the normal background condition of the soils at Edwards AFB.

South Base

- Monitoring wells were installed down gradient of Site 5 (Wells 13 and 14).
- At the time of this work, no fuel contamination of the groundwater was observed.
- One of the POL waste tanks at South Base (Site 5) leaked at one time. It has subsequently been emptied and is no longer used. This leaking condition has produced a layer of oil/fuel contaminated soil which is located at a depth of 45 feet and reaches a distance of at least 400 feet from the POL tank. The water table was found at 52 feet; it could be inferred that the tank leakage occurred when the water table was higher, leaving the contaminated soil behind as the water table dropped.

Site 2 and Site 3

- Lysimeters were installed at these sites for future monitoring.

RECOMMENDATIONS

A monitoring program is recommended to sample the lysimeters and wells which were installed during this work.

A program of study is recommended to develop a better understanding of the extent, nature, and potential for problems which might be caused by the contaminated soils found at the waste POL tanks, Site 5.

CHAPTER 1

INTRODUCTION

The overdrafting of the groundwater within Antelope Valley and specifically around Rogers Dry Lake near the aquifer boundaries has created unique hydrological conditions, with fluctuating water levels and continuously changing regimes of confinement, semiconfinement, and nonconfinement of the groundwater.

Groundwater in the major part of Antelope Valley, including the southern part of Rogers Dry Lake, occurs under confined conditions, even though in some cases the confinement is no longer effective to produce artesian flow due to overdraft. Along the "shores" of Rogers Dry Lake and north of the lake bed, groundwater occurs mainly under unconfined conditions.

The location and extent of water-bearing material is mainly dependent on the geologic history of an area. Antelope Valley is a triangular closed basin bordered by the active Garlock Fault to the north-northwest and the active San Andreas Fault to the south. Movement along these two faults, emplacement of granitic rocks, and regional uplift created the closed basin that exists today. During and following the uplift of the mountains, erosional processes were intensified. Precipitation resulted in runoff; the greater the surface gradient, the higher the velocities of the runoff, and therefore the higher the erosion potential. Eroded material from the mountains surrounding Antelope Valley was brought to the basin floor, including the Rogers Dry Lake area, by local streams. During times of heavy precipitation the eroded material consisted of mixed gravel and sand; the gravel and sand layers that are encountered today in the subsurface material have a relatively high porosity and excellent water-bearing capabilities. These layers constitute the main aquifers. Overlying and interfingering the sand and gravel are silt and clay lenses and layers which were deposited during times of little precipitation within the ancient lake that once covered the major part of Antelope Valley. These finer-grained materials have low porosity (45 to 50 percent) and permeability (0.0001 to 0.1 gallons/day/square foot). In many places, the clay and silt act as confining layers, preventing water within the lower-lying sand and gravel layers from rising to its potentiometric level. Figure 2.1 depicts a conceptual drawing of the transition zone between lake deposits and bedrock/

CHAPTER 2

ENVIRONMENTAL SETTING

GENERAL GEOLOGIC REGIME

Antelope Valley and the area surrounding Rogers Dry Lake have been the subject of geohydrological investigations since as early as 1911, when Harry R. Johnson authored "Water Resources of Antelope Valley" in U.S. Geological Survey (U.S.G.S.) Water-Supply Paper 278 (Johnson, 1911). Around the turn of the century it was discovered that the valley contained large quantities of groundwater that, when extracted through wells, could be used for irrigation, transforming the valley into productive agricultural land.

Hundreds of wells have been installed to tap valuable water resources, which in the early days were thought to be practically inexhaustible. Some people, however, recognized the fact that even though "water keeps spouting out from wells developed in areas of artesian groundwater conditions," the resource was indeed limited. In the 1911 report, Mr. Johnson cautioned that "even though the groundwater appears to be inexhaustible, it is indeed finite," and the continued unmanaged use of the resource could lower the level of the water table and eventually dry out the groundwater reservoir.

The same view was presented in the later U.S.G.S. Water-Supply Paper 578 (Thompson, 1929). That paper advocated conservation of the water supply if maximum use is to be obtained. However, during the past 70 years, extraction of groundwater has continued at a rapid pace with resulting declines in water tables and decreases in the areal extent of artesian conditions. The results, at least on the surface, have been to transform the nonirrigated lands from a semiarid grassland to a desert-like environment.

CHAPTER 2

ENVIRONMENTAL SETTING

(Stage 2). The result of that Stage 2 effort is the subject of this report. A copy of the ES Scope of Work has been included as Appendix A to this report (underlined portions are this Stage 2).

The supplementary program, Stage 2, consisted of the following:

- Installation of a monitoring well down gradient of Sites 1A, 1B, 1C, 1D1, and 1D2. Analyses of soil samples taken during construction of that well and initial analyses of water samples from the monitoring well.
- Installation of shallow borings radially located from Site 1D1 to determine the extent of gaseous contamination of soils.
- Installation of monitoring lysimeters at the periphery of Sites 2 and 3.
- Locating and sampling for fuel at existing Well 9N/9W-6C1 (MB-1) near Site 5.
- Redevelopment of existing well 9N/9W-6E1 and sampling for fuel.
- Installation of two monitoring wells down gradient from the POL tanks at Site 5 and analysis of initial samples taken from that well.
- Installation of one monitoring well down gradient from the industrial waste pond, Site 8. Analysis of initial samples taken from that well.
- Background soils sample taken about two miles to the north and east of the principal area of Base activities and analyzed for residual pesticides, PCBs, and metals.

TABLE 1.2 (Continued)

Site	Recommended Action and Monitoring	Rationale
8	° Install one groundwater monitoring well immediately down gradient from the site; sample groundwater for metals and organic solvents.	° Determine leakage from pond into the groundwater
	° If the groundwater shows no contamination, sample installed monitoring well annually.	° Monitor potential future leakage from pond into groundwater
	° If groundwater samples show contamination, the pond water could be treated in situ. Sample monitoring well semiannually.	° Reduce the potential for groundwater contamination; sampling of groundwater monitoring well will allow for determination of water treatment effectiveness
10	° Install vapor detection pipes around the perimeter of suspected contaminated area.	° Identify lateral extent of contaminated area and monitor evaporation of fuel over time
	° Institute land use restrictions.	° Prevent future excavation and construction in the area while fuel is still present in the soil
11	° Install one monitoring well immediately down gradient from the hydrant. Sample well water semiannually for fuels (the entire casing of the well should be perforated and the well sampled semiannually for gas vapors).	° Determine if fuel is present on top of the groundwater

TABLE 1.2 (Continued)

Site	Recommended Action and Monitoring	Rationale
2 (Cont'd)	° Install monitoring well if contaminants are detected in seasonal flow; sample annually for metals and suspected contaminants.	° Monitor potential migration of contaminants into groundwater
	° Construct an impermeable mound across the site.	° Prevent mobilization of contaminants by surface runoff
	° Institute land use restrictions.	° Prevent construction and excavation at future dates
3	° Install a lysimeter down gradient from the site; if seasonal groundwater flow exists, sample for metals and organics.	° Determine existence of seasonal groundwater flow; if flow exists, water sample analysis will identify potential contaminant migration
	° If contaminants are identified, install down-gradient monitoring well.	° Monitor potential migration of contaminants into groundwater
5	° Locate existing wells 9N/9W-18C1 and 9N/9W-6L1; take groundwater samples and water level measurements if possible, and analyze for fuel and oil.	° Establish boundaries for the lateral extent of potential fuel migration
	° If the wells 18C1 and 6L1 can be located, they should be abandoned by grouting.	° Eliminate possibility of potential contamination migration through the well into deeper aquifers
	° Redevelop existing well 9N/9W-6E1 and sample for fuel.	° Verify fuel contamination in well 6E1
	° Install 3 monitoring wells down gradient of site; sample for fuel. If no fuel is detected in the soil or groundwater, the new wells should be monitored semiannually; if fuel is detected, install 3 to 6 additional wells.	° Identify lateral extent of potential fuel migration
	° Monitor underground storage tanks regularly.	° Determine the potential for future leakage.

TABLE 1.2

RECOMMENDED ACTIONS AND MONITORING
EDWARDS AFB, CALIFORNIA

Site	Recommended Action and Monitoring	Rationale
1A, 1B, 1D1, 1D2	° Remove all waste containers from sites and dispose at permitted location.	° Prevent further soil contamination
	° Monitor down-gradient wells semiannually for organic constituents.	° Identify potential migration of contaminants within the groundwater
	° Install one down-gradient monitoring well and sample soils at the soil/water interface. Also sample groundwater for gaseous constituents.	° Define vertical extent of soil contamination
	° Complete 10-foot deep soil borings at compass points around the sites and sample for gaseous constituents.	° Define lateral extent of soil contamination
1C	° Construct impermeable mound across the nitric acid pits.	° Prevent mobilization of nitrates
	° Institute land use restrictions.	° Prevent construction and excavation at future dates
	° Monitor down-gradient wells.	° Identify potential migration of contaminants within the groundwater
2	° Locate and remove buried waste containers (if present) and dispose at permitted location.	° Prevent potential leaching of contaminants into groundwater
	° Install two lysimeters down gradient from the site. If flow exists, collect water samples and analyze for metals and suspected contaminants.	° Determine existence of seasonal groundwater flow; if flow exists, laboratory analysis of water samples will identify potential contaminant migration

were found throughout the entire soil column sampled at Site 1C. At Sites 1A, 1B, 1C, and 1D, soil samples from the greatest depths (55 feet to 61 feet) showed chemical constituents present in detectable concentrations, but the levels of soil contamination identified at these sites would be unlikely to constitute an immediate health hazard. Groundwater was not encountered in any of the soil borings.

At Site 2, chromium and tetraethyl lead were detected throughout the soil column. Contamination of the groundwater from leachates originating at Site 2 is considered unlikely. Soil samples from Site 3 contained constituents, particularly pesticides, with concentrations higher than normally would be expected. The concentration levels in the soil samples were all lower than the established California threshold limit concentrations. The potential for environmental health hazards from this site is considered minimal, primarily due to the absence of a permanent water table under the area. Groundwater samples from Phase II monitoring wells installed around Site 5 indicated no contaminants present in any of the samples; this could be a result of shallow groundwater flow in a direction different from the expected regional flow regime.

Results of analyses of the water and sediment samples collected from Site 8 indicate the presence of metals. However, groundwater contamination from this site is considered unlikely due to the low permeabilities of the underlying deposits and the probable impermeability of the bottom sediment. In the soil borings at Site 10, fuel was found to be present within the soil column. Near Site 11, fuel was identified in the groundwater at one monitoring well, while no fuel was identified in the other well. The likelihood of groundwater contamination from the fuel spill at this site is considered to be low.

Recommended follow-on actions and future monitoring for each site are summarized in Table 1.2.

SCOPE OF WORK

Based upon the foregoing recommendations, the Air Force elected to implement a supplementary exploration/confirmation/monitoring effort

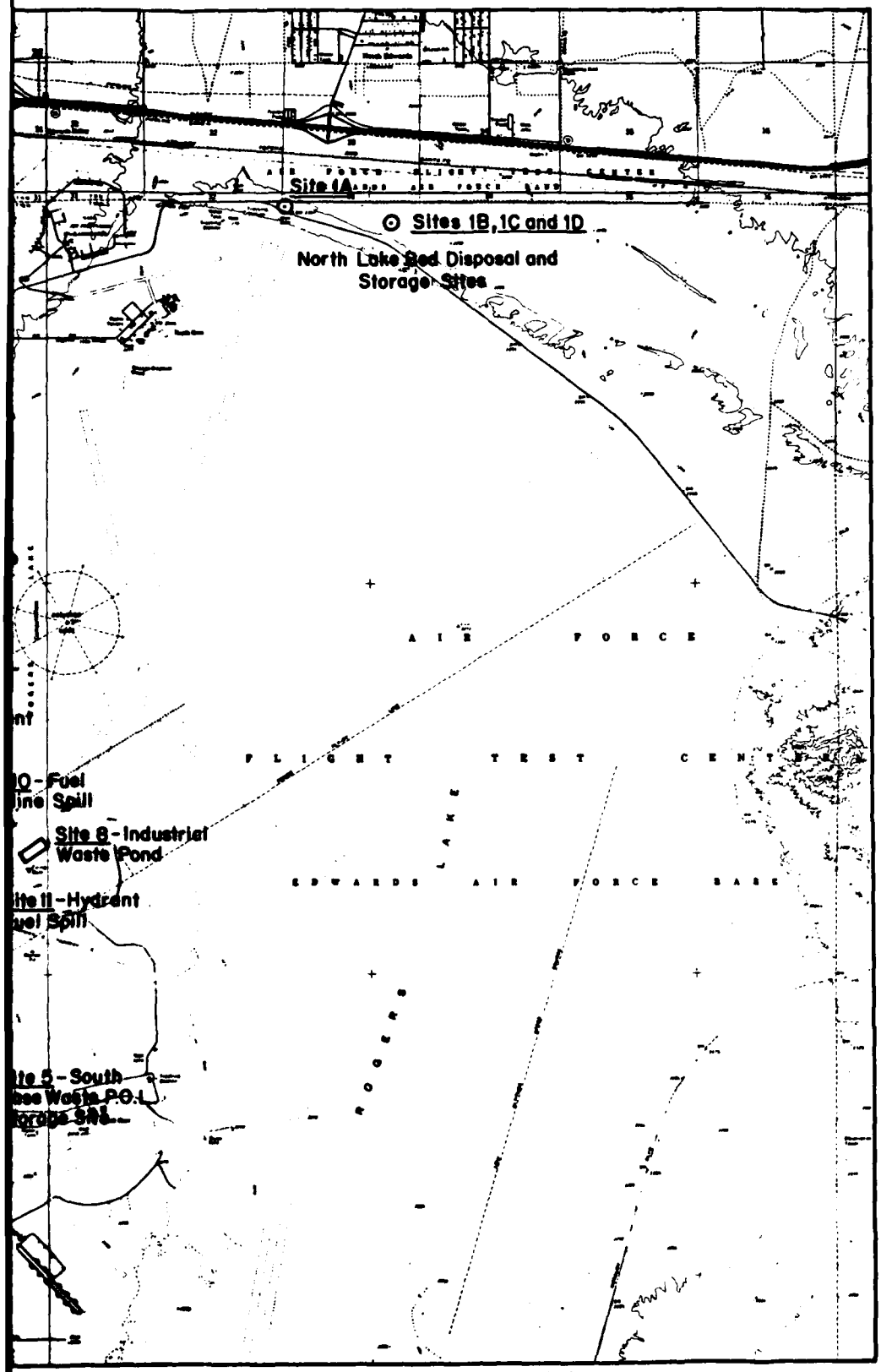
TABLE 1.1

STORAGE AND DISPOSAL SITE CHARACTERISTICS
EDWARDS AFB, CALIFORNIA

Site	Activity	Waste Characteristics	General Subsurface Material	Depth to Groundwater	Distance to Closest Active Production Well (feet)
1A	Drum storage (13 barrels) ABANDONED 1978	Motor oil, dry cleaning solvent, lube oil, miscellaneous solvents	Lakeshore deposits (sand)		1,300
1B	Drum storage (116 barrels)	Aniline	Playa deposits		
1C	Acid pits, open trenches (4)	Fuming red and white nitric acids, burnt waste fuels	Sand dune underlain by playa deposits		4,000
1D	Drum trenches (2) (hundreds of barrels) ABANDONED	Aniline, furfural alcohol, engine cleaner, ethyl alcohol	Playa deposits		4,000
2	Toxic waste disposal ABANDONED 1960s	Cyanide, chromate, nitric acid, tetra-ethyl lead, hydrogen peroxide, fuels	Loose sand	No aquifer (closest aquifer 3,500 feet away)	
3	Main Base sanitary landfill ABANDONED 1970s	Possibly hazardous wastes and banned pesticides	Sandy (younger fan deposits)	No aquifer, ground sloping toward arroyo draining into Rogers Dry Lake	
5	South Base waste POL storage and disposal site, underground tanks and 70 barrels	Water-contaminated fuels and oils, synthetic ester oil, jet fuel, hydraulic fluid	Young alluvium	85 feet	4,000
8	Industrial waste pond ACTIVE	Runway runoff and washdown, fuel spills, hangar drainage	Lake shore deposits (thin)	Underlain by ground-water mound	

Reference: Envirodyne Engineers, Inc., 1981

FIGURE 1.1



REGIONAL LOCATION MAP

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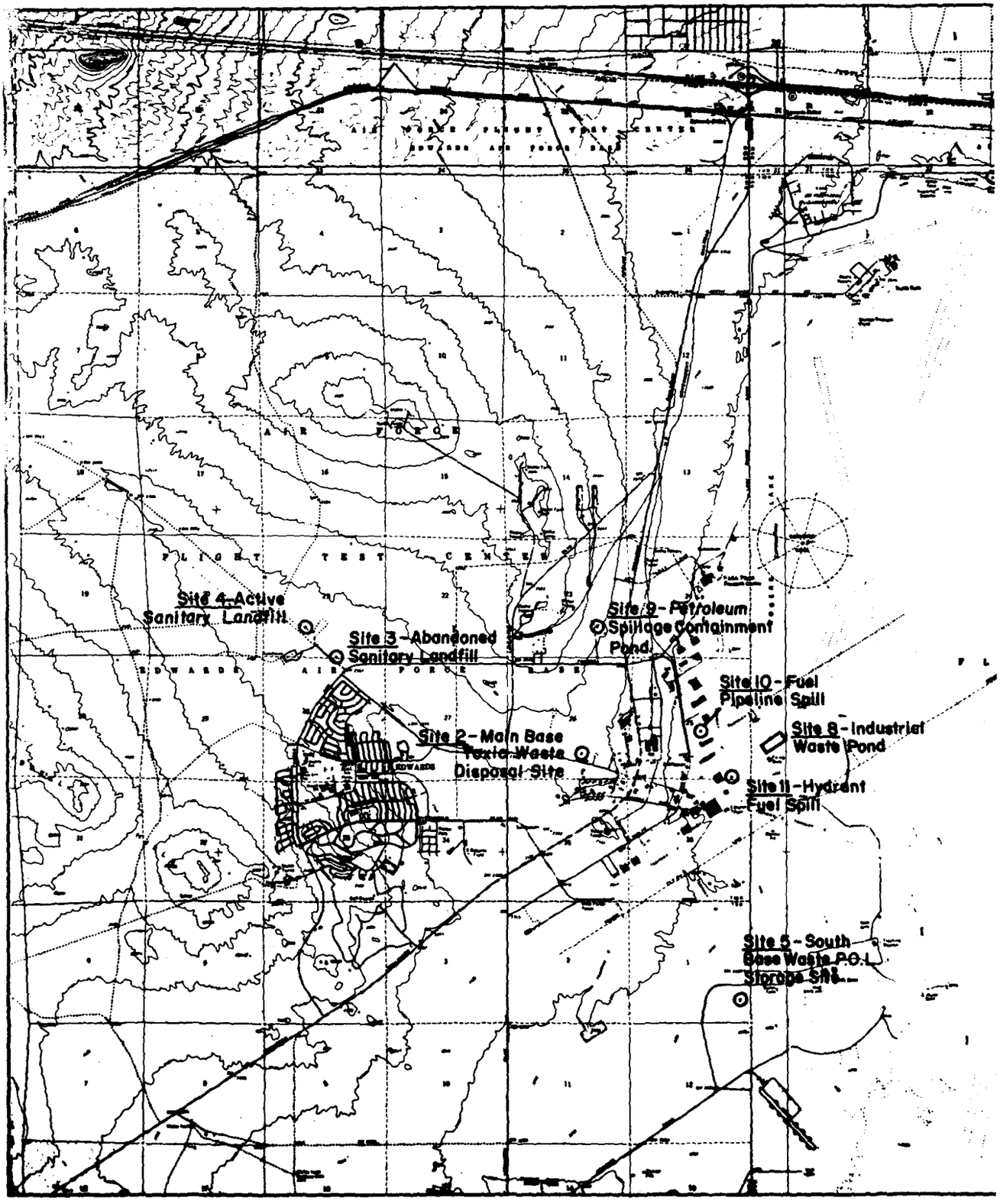
KNOWN PAST AND CURRENT DISPOSAL AND STORAGE AREAS EDWARDS AFB

ENGINEERING-SCIENCE


Site 4-Active Sanitary Landfill
Site 3-Abandoned Sanitary Landfill
Site 9-Petroleum Spillage Containment Pond
Site 10-Fuel Pipeline Spill
Site 8-Industrial Waste Pond
Site 2-Main Base Toxic Waste Disposal Site
Site 11-Hydrant Fuel Spill
Site 5-South Base Waste P.O.L. Storage Site

Phase II actions are required for these sites at this time. The eight sites studied in Phase II are shown in Figure 1.1 and are described in Table 1.1.

WORK CONDUCTED IN PHASE II

On the basis of the Phase I Assessment of the Potential for Groundwater Contamination performed in April 1981, the Installation Restoration Program, Phase II - Confirmation has been conducted. The purposes of this program have been to:

- Determine the extent and magnitude of environmental contamination resulting from previous waste disposal practices at Edwards AFB, California
- Recommend measures to alleviate impacts for identified contaminated areas
- Develop environmental monitoring programs to document environmental conditions resulting from past waste disposal activities at Edwards AFB

To accomplish these tasks the ES work program included the installation of monitoring wells and completion of soil borings for collection of water and soil samples as well as the collection of surface soil samples. The Installation Restoration Program, Phase II - Confirmation report presents the results of the first stage of the project, including development and implementation of the field program, the sampling procedures utilized to obtain data, data analysis, conclusions, and recommendations for future actions.

Findings and Recommendations - First Stage of Phase II

Laboratory analyses of soil samples taken from borings at Sites 1A, 1B, 1C, and 1D indicate that most of the chemical constituents suspected at each site were not present in detectable amounts. Generally, the analytical results from each of these sites except 1C showed the presence of volatile substances (chloroform and trichlorofluoromethane) within the soil column; small quantities of other constituents were detected at various sites and depths. Nitrates in high concentrations

as a basis for response actions on Air Force installations under the provisions of the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) of 1980.

The Installation Restoration Program has been developed as a four-phased program. These phases are:

- Phase I - Installation Assessment
- Phase II - Confirmation
- Phase III - Technology Base Development
- Phase IV - Operations

Phase I, completed at Edwards Air Force Base in April 1981, includes the identification and prioritization of past disposal sites that may pose a hazard to public health or the environment as a result of contaminant migration. Phase II involves a comprehensive preliminary environmental and/or ecological survey to define and quantify the presence or absence of contamination that may adversely affect public health or the environment. During Phase III, a sound data base will be developed upon which to prepare a comprehensive contaminant control plan. This contaminant control plan and remedial measures will be implemented in Phase IV.

PREVIOUS WORK

The Phase I study completed in 1981 assessed the potential for groundwater contamination on Edwards AFB, California (Envirodyne Engineers, Inc., 1981). The study provided a general description of the existing climatological, geological, and hydrological regimes at the Base and in its immediate vicinity.

Twelve active and inactive waste disposal sites were identified and evaluated in the report on the basis of site characteristics, potential for contamination, waste characteristics, and waste management practices. The evaluation consisted of assigning to each site numerical values weighted on a subjective scale according to degree of severity for contamination potential. Based on this evaluation, four of the twelve sites were subsequently dropped from further consideration; no

CHAPTER 1

INTRODUCTION

PREFACE

Engineering-Science, Inc. performed explorations and studies which resulted in a report entitled Installation Restoration Program, Phase II - Confirmation, Edwards AFB, California. This report was submitted in September 1982. As a result of the findings of that report, ES was asked to perform further explorations and studies. This report presents the results of later work performed.

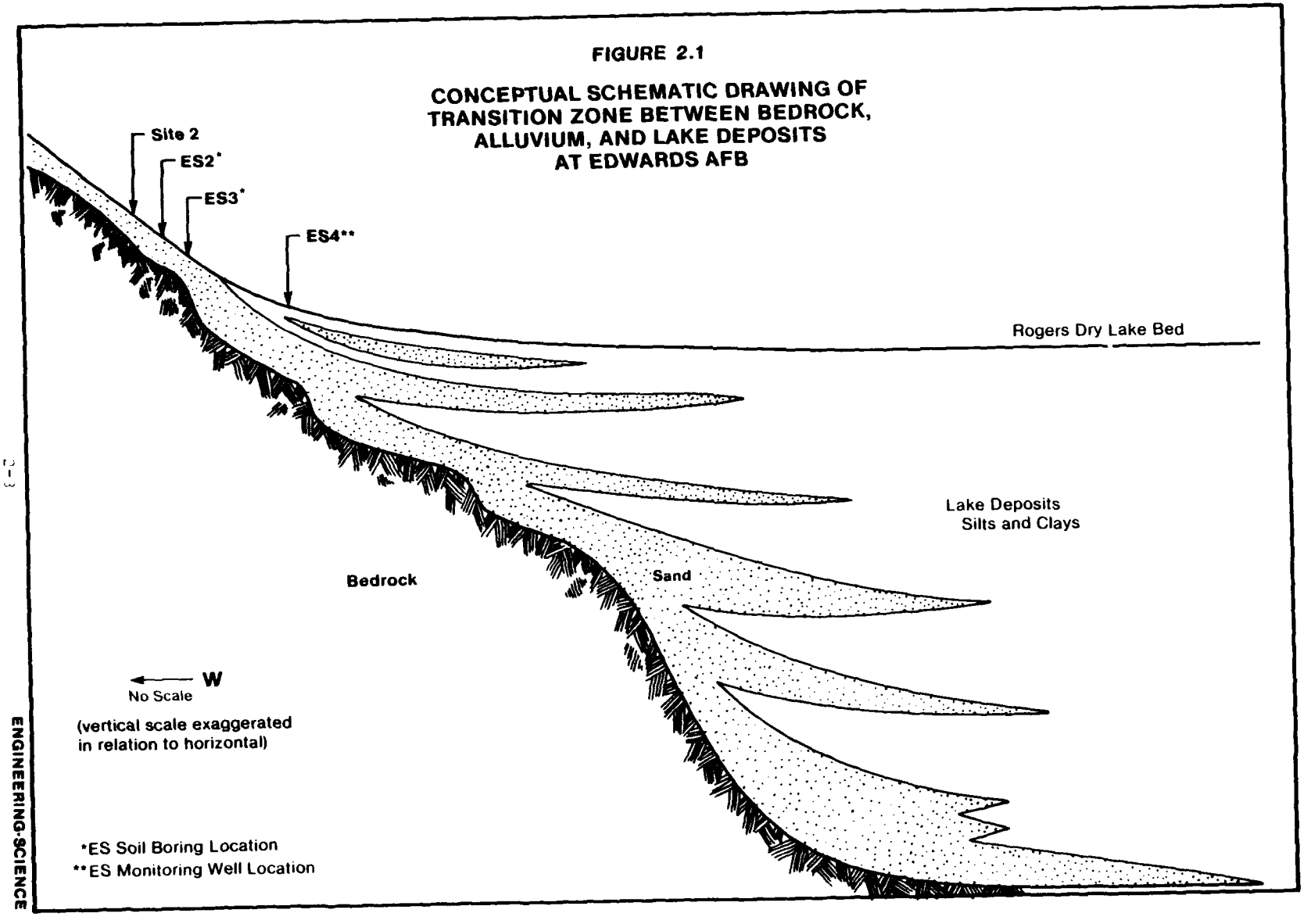
In order for the user to be able to read this report without continuous reference to the earlier report, ES has elected to reproduce and excerpt sections of the earlier report and include them as a part of this document. ES hopes this will allow this supplemental study to stand alone.

BACKGROUND

The United States Air Force, due to its primary mission, has long been engaged in a wide variety of operations dealing with toxic and hazardous materials. Federal, state, and local governments have developed strict regulations to require that disposers identify the locations and contents of disposal sites and take action to eliminate the hazards in an environmentally responsible manner. The Department of Defense (DOD) has issued Defense Environmental Quality Program Policy Memorandum 81-5 which requires the identification and evaluation of past hazardous material disposal sites on DOD property, the control of migration of hazardous contaminants, and the control of hazards to health or welfare that resulted from these past operations. This program is called the Installation Restoration Program (IRP). The IRP will serve

FIGURE 2.1

CONCEPTUAL SCHEMATIC DRAWING OF TRANSITION ZONE BETWEEN BEDROCK, ALLUVIUM, AND LAKE DEPOSITS AT EDWARDS AFB



alluvium material; as illustrated, recharge to the shallower water-bearing sands could occur through the "daylighting" layers (U.S.G.S., 1980).

GENERAL HYDROLOGIC REGIME

Water within the groundwater basin is derived from several sources. Some water is connate water, i.e., water trapped within the sediments from the time of deposition. Other water is provided through recharge into the water-bearing materials along the basin boundaries where sand and gravel layers "daylight"; still another source is from percolation through the valley floor. Figure 2.2 shows the surface geology at Edwards AFB and in the vicinity of Rogers Dry Lake; as can be seen, the lake is bordered by a variety of sand, gravel, and silt deposits consisting of younger alluvium (yielding water to wells when saturated), younger fan deposits (primarily located above the water table, yielding little water to wells), lakeshore deposits (above the water table), old windblown sand, and dune sand (yielding water locally to wells from perched water tables).

Groundwater recharge from the valley floor (Rogers Dry Lake) is quite limited. The lake bed surface consists of playa deposits, silt, and clay which have low permeabilities, retarding downward migration of water. Water ponding on the lake surface during the rainy season primarily evaporates; limited seepage may occur through cracks developed during the summer, but the contribution of rainwater to the aquifer system should be limited.

Groundwater flow and direction in the main water-producing aquifers near Edwards AFB are largely dominated by pumping wells, resulting in changes in the regional gradient from north to south. Figure 2.3 shows the groundwater table contours as of 1979 (U.S.G.S., 1980). A groundwater trough was located immediately south of the Main Base as a result of groundwater pumping; the groundwater table elevation at that time was estimated to be about 2,200 feet above mean sea level, or 100 to 120 feet below the ground surface. Groundwater in the vicinity of the trough is moving toward this depression from the north, south, and west; to the east is the boundary of the valley aquifer systems. It should be

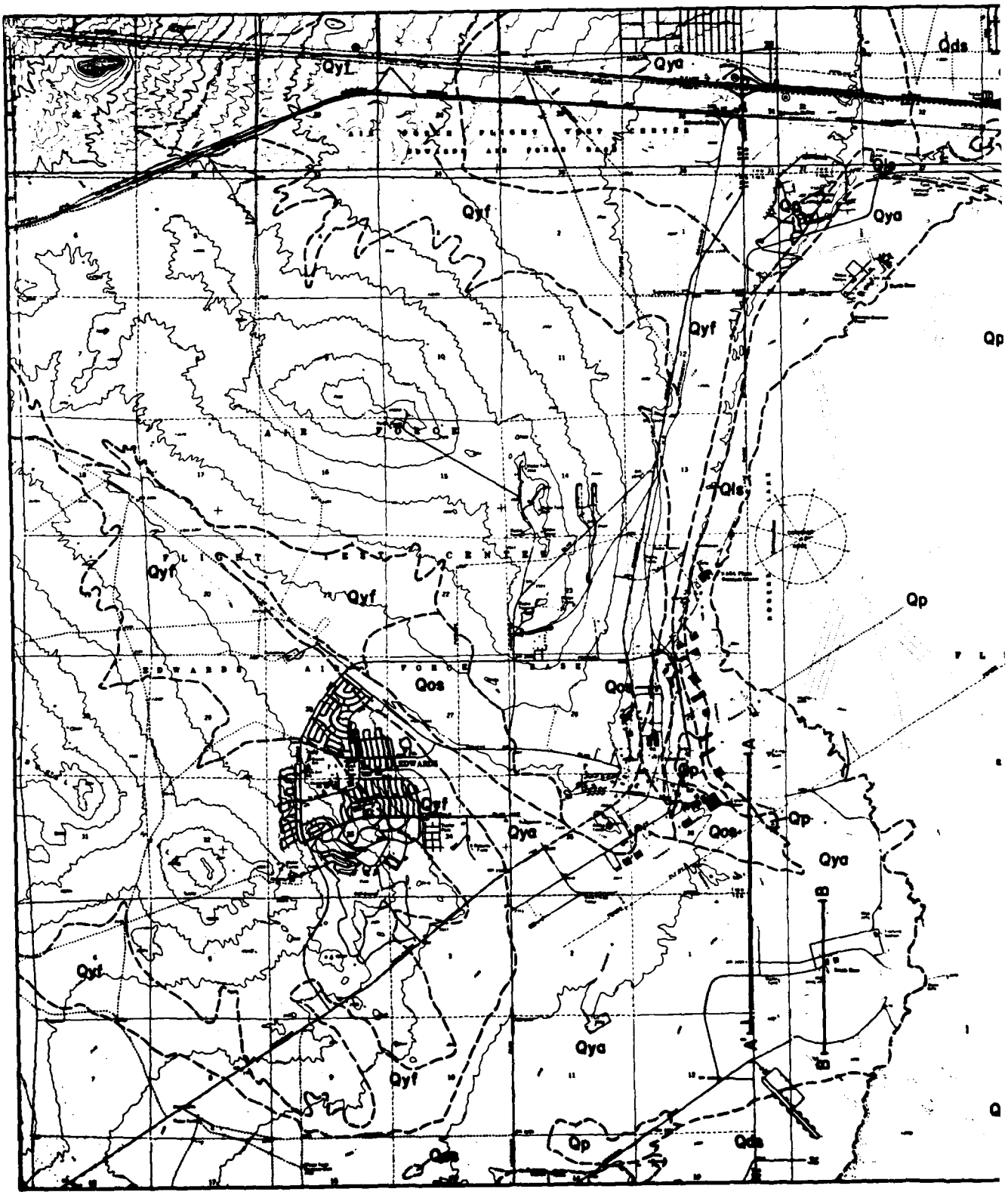

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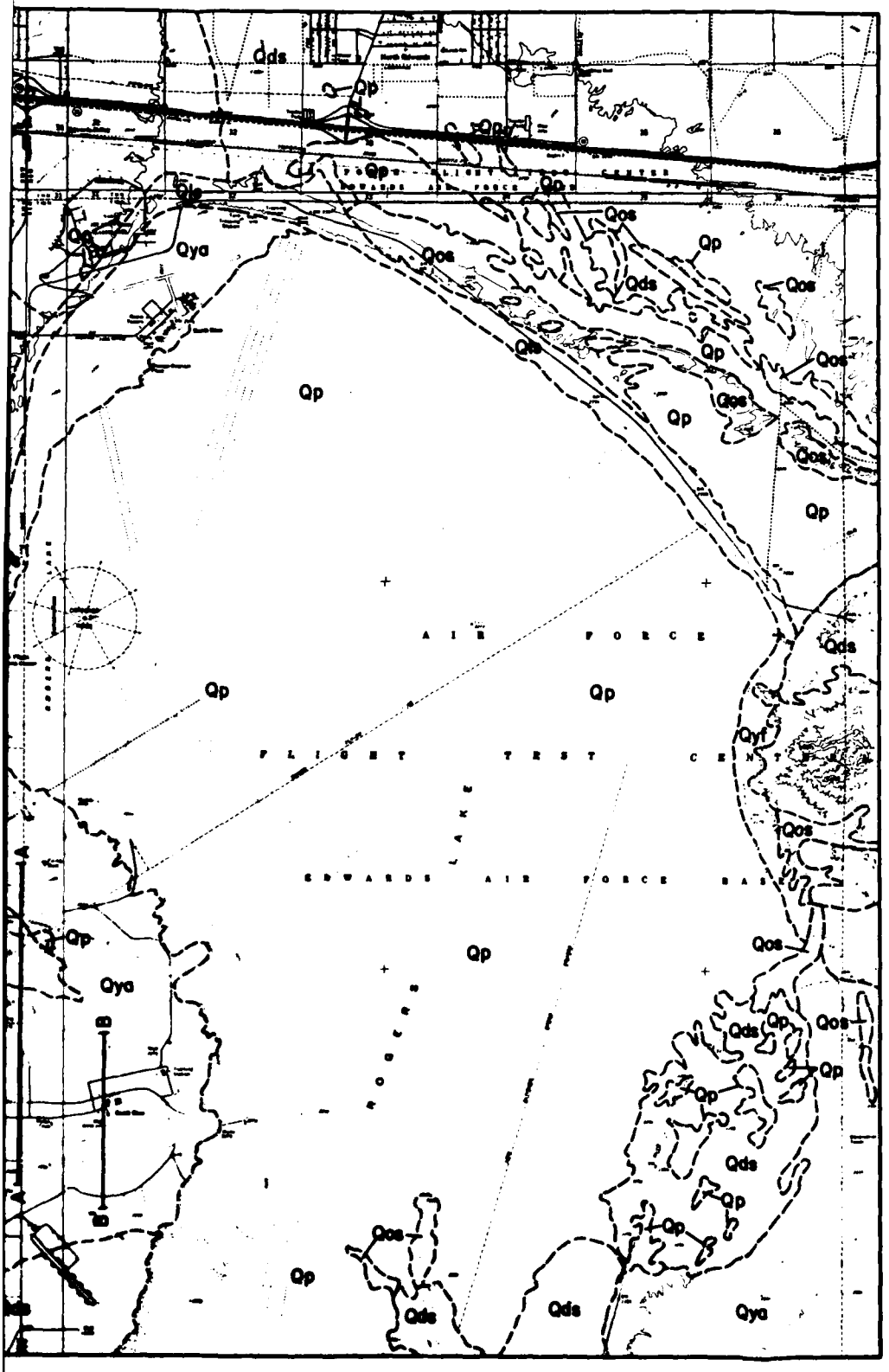
FIGURE 2.2



LEGEND

- Qya — Younger Alluvium
- Qyf — Younger Fan Deposits
- Qp — Playa Deposits
- Qds — Dune Sand
- Qos — Old Windblown Sand
- Qls — Lakeshore Deposits
- A — A' — Location of Geologic Cross-Section

Source: U.S. Geol. Survey Bulletin No. 91-6, 1962.

1/2 0 1
MILE

N

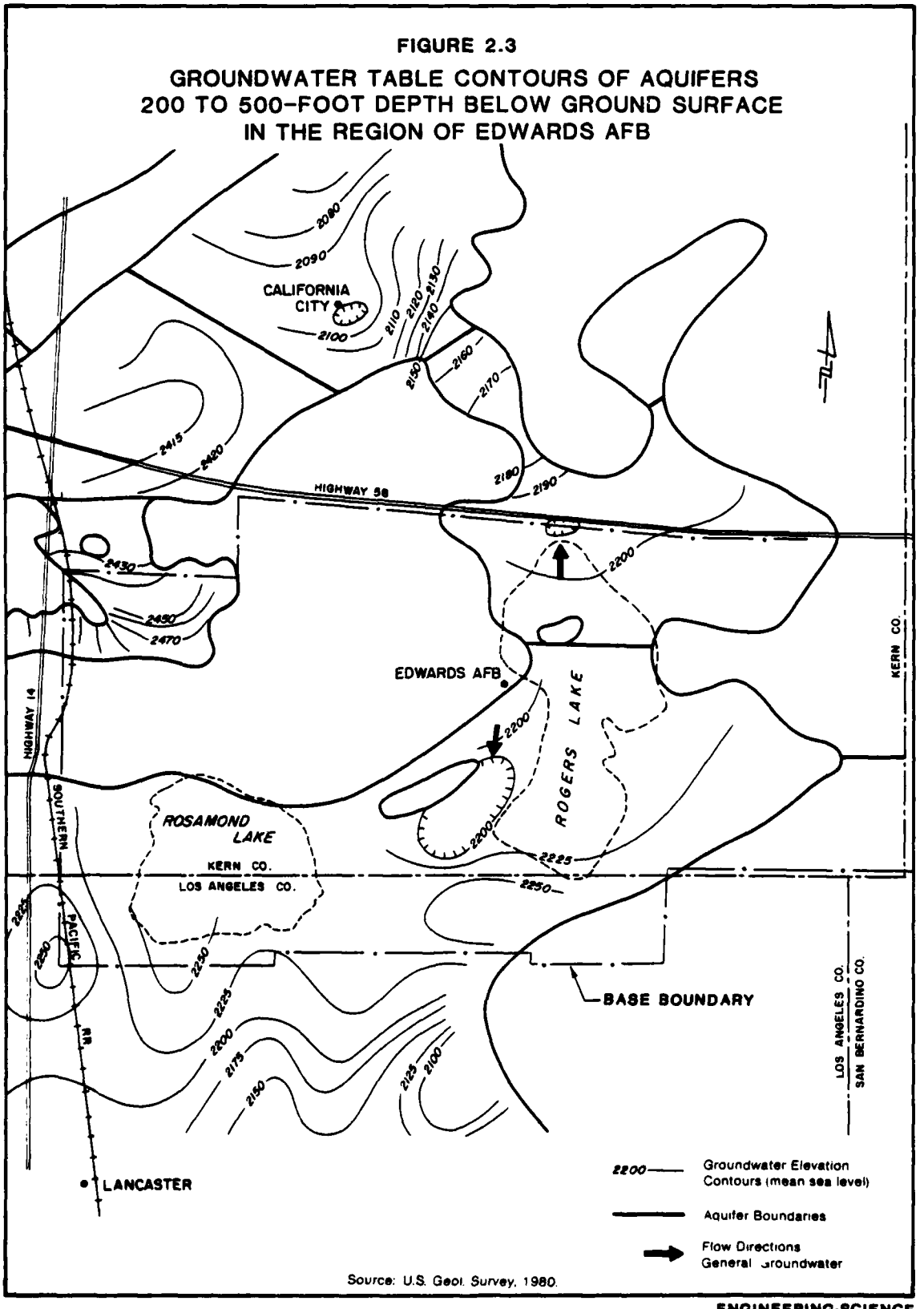
GEOLOGY IN THE VICINITY OF EDWARDS AFB

ENGINEERING-SCIENCE

(2)

FIGURE 2.3

GROUNDWATER TABLE CONTOURS OF AQUIFERS 200 TO 500-FOOT DEPTH BELOW GROUND SURFACE IN THE REGION OF EDWARDS AFB



Source: U.S. Geol. Survey, 1980.

noted, however, that these groundwater contours are based on water level measurements from wells penetrating to depths of 200 feet to 500 feet, and are therefore not indicative of shallow groundwater conditions (Moyle, 1982).

Along the northern shores of Rogers Dry Lake by the North Base, the groundwater movement is in a south-to-north direction; a trough exists immediately around this part of the Base due to local groundwater extraction. A groundwater barrier exists just north of the Main Base across the dry lake bed, consisting of a zone of material with low permeability; this barrier is possibly the extension of the Muroc Fault trending in a northwest-southeast direction. The elevation of the groundwater in the North Base area was about 2,190 feet in 1979. Groundwater level contours for this area are included on Figure 2.3.

CHAPTER 3

FIELD PROGRAM

CHAPTER 3

FIELD PROGRAM

NORTH BASE - GROUNDWATER MONITORING WELL (SITES 1A, 1B, 1C, 1D)

One groundwater monitoring well (Well 12) was installed down gradient adjacent to the nitric acid pits (Site 1C) at North Base. The location of this well is shown on both Figures 3.1 and 3.2. Initially the well was to be drilled using the hollow-stem auger method; however, the sediments underlying the site made penetration at depth infeasible; as drilling progressed the drilled hole would not remain open, and the drill hole caved in. Thus it became necessary to complete the hole using rotary wash drilling.

During the augering phase, in-place soil samples were collected for laboratory analyses at depths of 10, 20, 45, 55, 65, and 103 feet. The samples were collected by a California Modified Sampler previously rinsed with methanol and deionized water; the sample was introduced into an acid-washed glass bottle and iced prior to shipment to the laboratory. These samples were analyzed for nitrates using an aqueous extraction followed by automated cadmium reduction.*

Well 12 was completed by rotary wash drilling, using water and super gel-x** as the drilling fluid to maintain an open hole. The well was drilled to a total depth of 148 feet. The geologic logs for all wells completed are contained in Appendix B. The well was constructed as explained in the well logs.

After completion of well construction and development by bailing, the water level in the well stabilized at 101 feet below ground surface.

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* Standard Methods for The Examination of Water and Wastewater.

** Super gel-x, a commercial bentonite yielding high viscosity in drilling fluids.

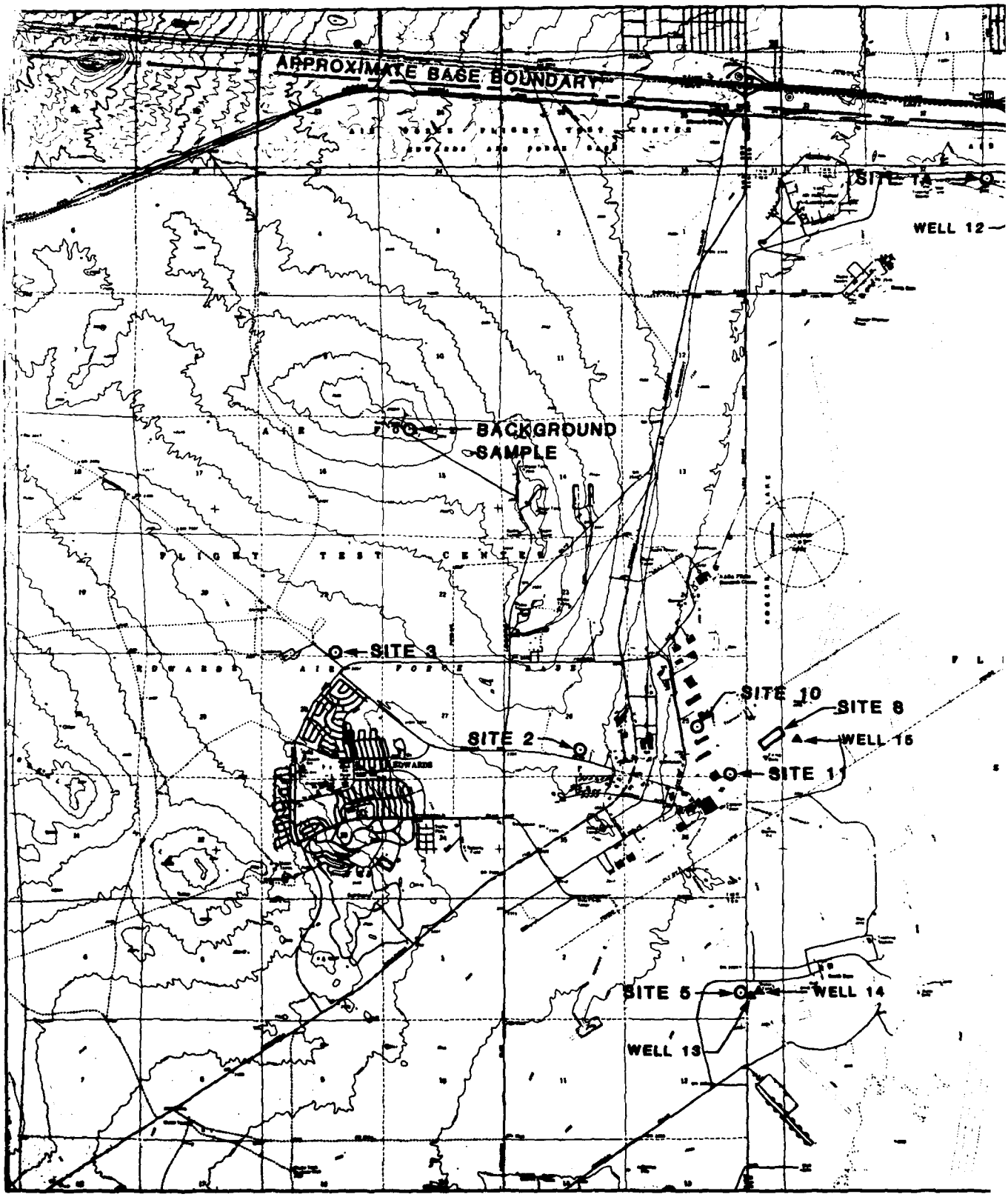
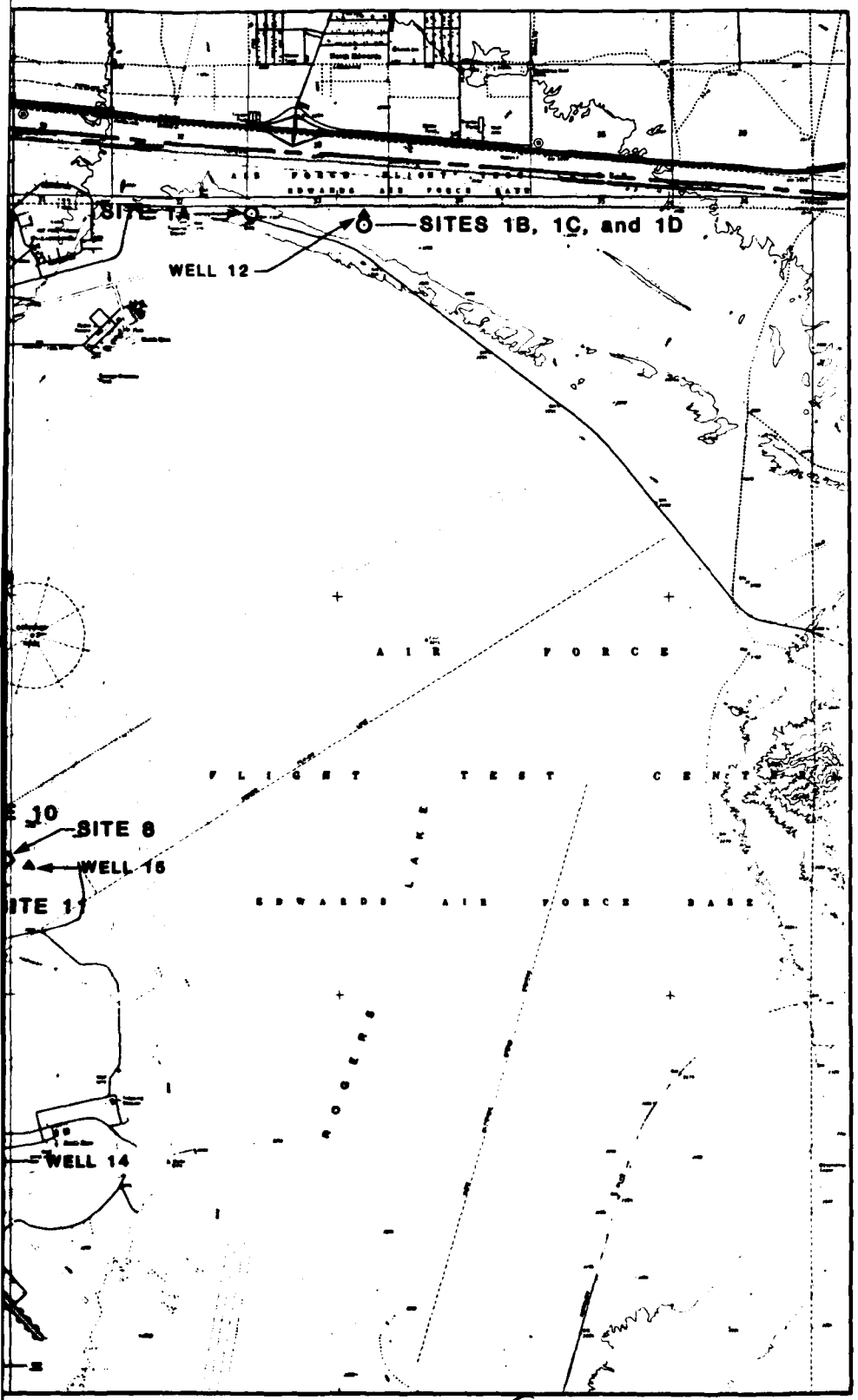

APPROXIMATE BASE BOUNDARY
SITE 12
WELL 12
BACKGROUND SAMPLE
SITE 3
SITE 10
SITE 8
WELL 15
SITE 2
SITE 11
SITE 5
WELL 14
WELL 13

FIGURE 3.1



LEGEND

▲ WELL LOCATIONS

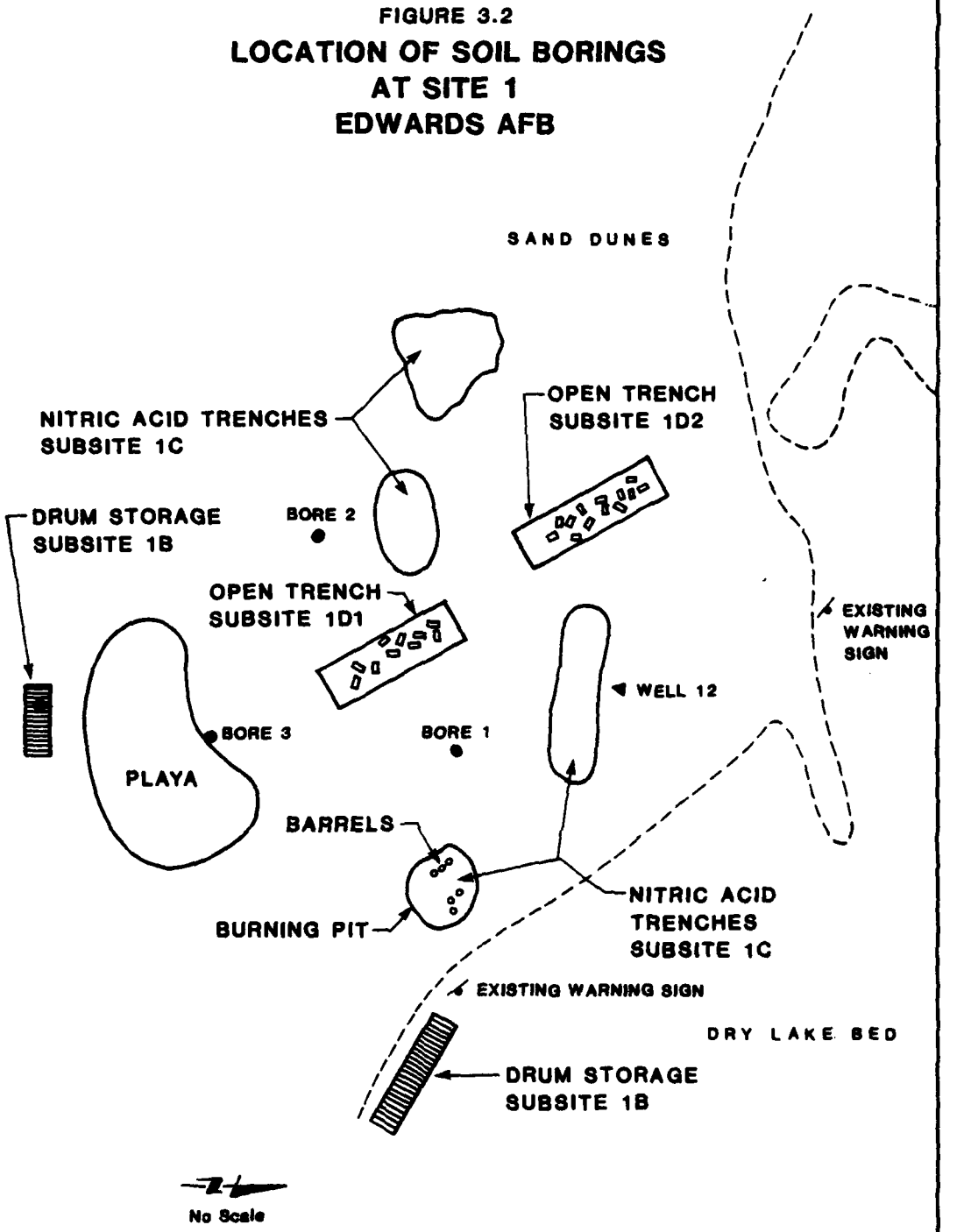
1/2 0 1
MILE

LOCATION OF WELLS INSTALLED AT EDWARDS AFB IN AUGUST-SEPTEMBER 1983

ENGINEERING-SCIENCE

FIGURE 3.2

LOCATION OF SOIL BORINGS AT SITE 1 EDWARDS AFB



The water-bearing materials were encountered at 135 feet. The water level was stable at 101 feet; the groundwater is assumed to be under confined conditions.

After development of Well 12, a groundwater sample was collected with a Teflon bailer. The sample was introduced into a polyethylene bottle and preserved with sulfuric acid, it was then iced, and brought to the laboratory for analysis.

NORTH BASE - SHALLOW SOIL BORINGS

In addition to the groundwater monitoring well at North Base, three shallow soil borings were completed in this area to confirm possible presence of chloroform and trichlorofluoromethane. The hollow-stem auger borings penetrated to a depth of 10 feet at the locations shown on Figure 3.2. An initial location for Bore 2 had to be abandoned, since refusal was met at a depth of 7 feet. It is unknown what material caused the refusal, but due to the possibility of buried wastes invalidating the data, the hole was abandoned.

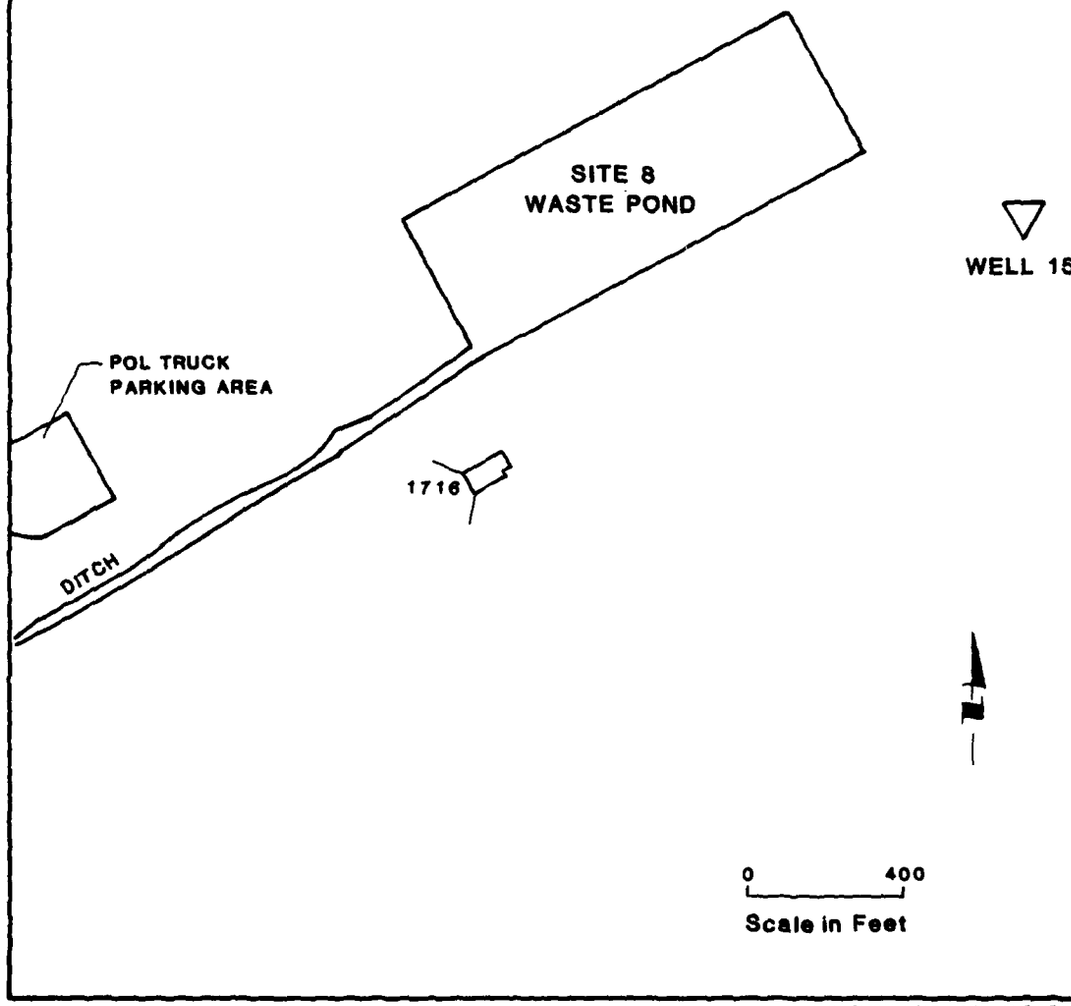
The samples were collected at the base of the boring using the California Modified Sampler previously washed with methanol and deionized water. The brass tubes were capped with aluminum foil and plastic caps. The samples were iced and brought to the laboratory. Samples were analyzed for chloroform and trichlorofluoromethane, using EPA Method 601 modified for acceptance of solids.

MAIN BASE - SITE 8

Near the Main Base area, one groundwater monitoring well (Well 15) was installed down gradient from the industrial waste pond, Site 8. The location of the well is shown on Figures 3.1 and 3.3. The well was completed using the rotary wash method to a depth of 45 feet, after initial drilling by hollow-stem auger caused the bore to cave in. (The drilling log and well construction summary are contained in Appendix B.) The water level in the well after drilling stabilized at 27 feet below ground level. During auger drilling, undisturbed, in-place soil samples were collected by a California Modified Sampler. The sample was introduced into an acid-washed polyethylene bottle, iced, and brought to the

FIGURE 3.3

SITE 8
INDUSTRIAL WASTE POND
EDWARDS AFB



ENGINEERING-SCIENCE

laboratory for metals analysis. After the well was developed, a groundwater sample was collected using a Teflon bailer. The sample was transferred to an acid-washed polyethylene bottle, iced, and brought to the laboratory for metals analyses. The analytical method consisted of acid digestion of the soils followed by atomic absorption spectrophotometry.

MAIN BASE - SITES 2 AND 3

Two lysimeters were installed near the Main Base; one near Site 2 (the Main Base toxic waste disposal site), and the other near Site 3 (the abandoned sanitary landfill). Figure 3.4 shows the location of the two lysimeters. Description of the lysimeters and sampling methodology are contained in Appendix C. The lysimeter holes were drilled with a hollow-stem auger, eight inches in diameter. Since no water was initially present in the soil, the lysimeters were not sampled. (Edwards Hospital Bioenvironmental Engineering Section will monitor the lysimeters and sample if any water appears.)

At Site 2 the lysimeter was installed at a depth of 5.5 feet in weathered granite. A soil slurry, consisting of native soil and tap water, was backfilled around the porous cup, and the tube extending the entire length of the lysimeter was marked with red tape. The first sampling of the lysimeter may contain some water from the soil slurry around the porous cup.

At Site 3, the lysimeter was installed in the same manner as the lysimeter at Site 2. It was located at the south side of Mojave Boulevard at a depth of 10 feet in weathered granitic material. An attempt was made to install the lysimeter on the north side of Mojave Boulevard; however, at a depth of one foot, landfilled material was encountered, and the hole was abandoned. A new hole was drilled across the roadway to avoid direct contact with landfilled material.

Background Sample

One background soil sample was collected at the location shown on Figure 3.1. The sample was taken immediately downslope from Building 4789 on granitic bedrock overlain by about one inch of weathered material. The sample was collected with a shovel, which had been rinsed in methanol and deionized water. The sample was split; one portion was

TABLE 4.6

ANALYTICAL RESULTS FROM SOIL AND WATER SAMPLES
AT WELLS 13 AND 14
SOUTH BASE, EDWARDS AFB

Location	Fuels Concentration
Well 13	
Soil, 20 ft	<100 mg/kg
Soil, 30 ft	<100 mg/kg
Soil, 40 ft	<100 mg/kg
Soil, 45 ft	4,000 mg/kg
Soil, 50 ft	<100 mg/kg
Water	<20 mg/l
Well 14	
Soil, 20 ft	<100 mg/kg
Soil, 30 ft	<100 mg/kg
Soil, 40 ft	<100 mg/kg
Soil, 45 ft	300 mg/kg
Soil, 50 ft	<100 mg/kg
Water	<20 mg/l

occurred in both wells with the appearance of gravels and a change from damp to moist sediments in Well 14. This may be indicative of a seasonal perched water table on top of which fuel may migrate down gradient. It should be noted that during drilling fuel, smells were noted from 22 feet to 52 feet in Well 13, and at 45 feet in Well 14. No fuel was detected above the detection limit (20 mg/l) in either of the groundwater samples, and no visual evidence of fuel was identified during water sampling.

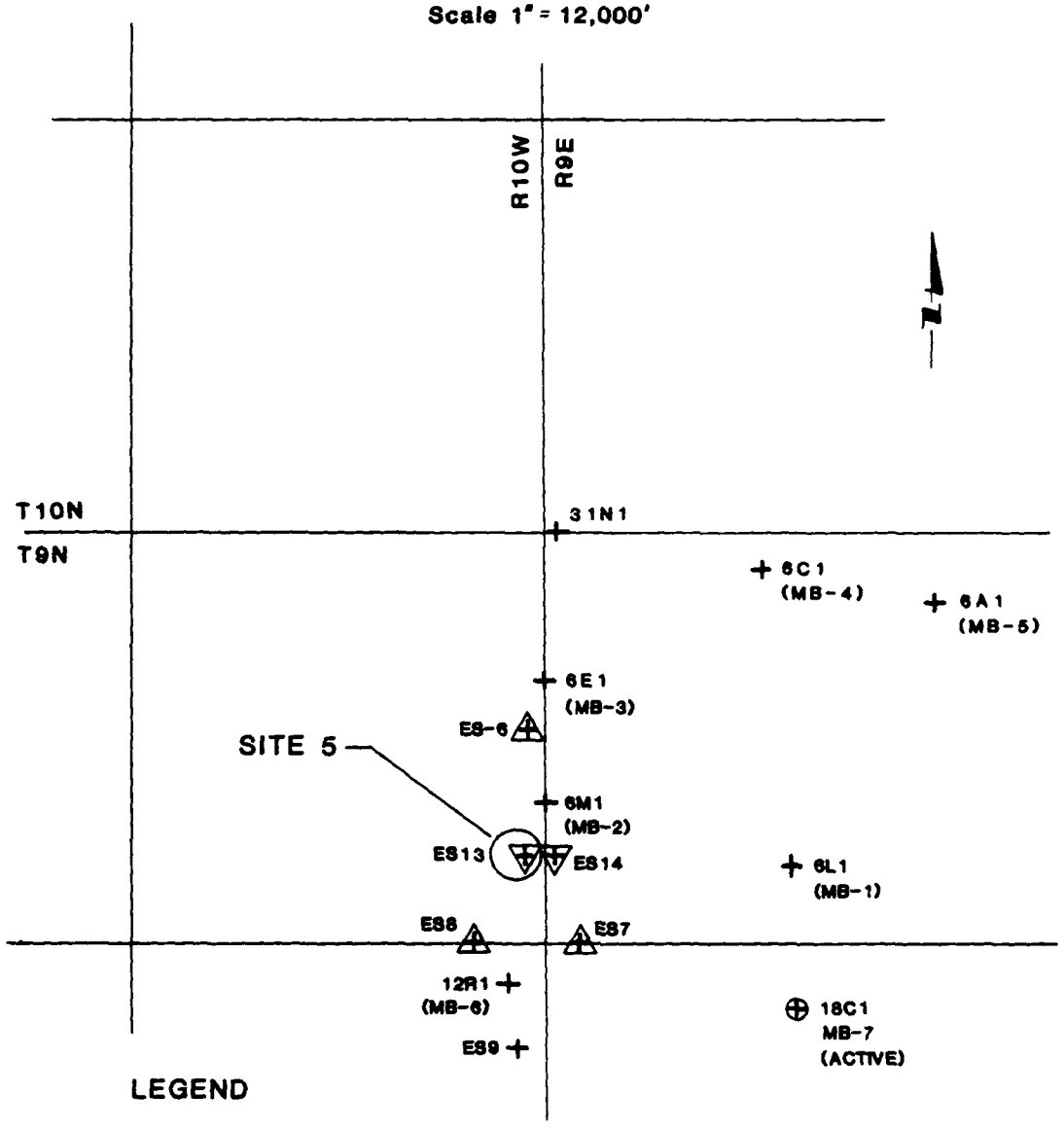
Well 6E1 was well pumped and cleared (see Appendix D for data). A water sample collected from Well was analyzed, using the same methodologies as for MB-1. The sample showed no evidence of fuels at a detection limit of 20 ppm. It must be concluded that the oil found in the well in 1982 may have resulted from an unauthorized dumping incident.

Main Base Well No. 1 (MB-1) (6L1) is an old well with a yield so low that it was never used as a production well. Initially, this well was sampled for evidence of fuels; none was found. The well was then

FIGURE 4.1

SITE 5 - SOUTH BASE
EDWARDS AFB AND ENVIRONS

Scale 1" = 12,000'



LEGEND

- + Old Abandoned Wells
- ⊕ Active Well
- Wells Drilled by ES During Stage 1, IRP Phase II
- Wells Drilled by ES During This Effort

ENGINEERING-SCIENCE

SOUTH BASE

The problem of soil contamination and possible future groundwater contamination at South Base is due to leaking underground waste POL tanks. These tanks are referred to as Site 5. Site 5 and the many existing and recently drilled wells nearby are shown in Figure 4.1.

Prior to the IRP Phase II Study, it was thought, based on water level data, that the upper aquifers underlying Site 5 flowed in the same direction as the underlying useful aquifer, north to south. To investigate the impact of leakage from Site 5, wells were drilled up gradient (ES 6) and down gradient (ES 7, ES 8, ES 9) of the tank. These wells revealed two facts:

- The wells and soils sampled during the drilling were not contaminated with oil or fuel.
- The upper aquifer appeared to flow from west to east.

Based on these facts and the observation of oils in Well 6E1, it was decided to embark on the following program:

- Drill wells at 40 and 400 feet toward the east of the site to locate potential oil contamination: these are Wells 13 and 14, respectively.
- Investigate 6E1 to determine the source of the oil found there.
- Investigate 6L1 to determine evidence of oil contamination at that point.

FINDINGS AT SOUTH BASE

Table 4.6 contains the analytical results obtained from analyzing soil and water samples from Wells 13 and 14. Field observations on fuel smell from the soils during drilling and sampling are included in the geologic logs in Appendix B (fuel was smelled from 22 feet to 52 feet in Well 13, and at 45 feet in Well 14 during drilling).

The analytical results from both wells indicate that the soil contains fuels at a depth of 45 feet, with the higher concentration near the POL storage area. At about the 40-foot level lithological changes

TABLE 4.5

PESTICIDE-PCB ANALYSES RUN
EDWARDS AFB - BACKGROUND SAMPLE

Compound	Level of Detectability (ppb)
α BHC	2
β BHC	2
δ BHC (Lindane)	2
BHC	2
Heptachlor	2
Heptachlor Epoxide	2
Aldrin	2
Dieldrin	2
Endrin	5
Endosulfun I	2
Endosulfun II	5
Endosulfun Sulfate	10
p,p¹ DDE	2
p,p¹ DDD	5
p,p¹ DDT	5
p,p¹ Methoxychlor	10
Aroclor 1016	10
Aroclor 1248	10
Aroclor 1254	10
Aroclor 1260	10
2,4-D	2
2,4,5-TP (Silver)	2
2,4,5-T	2

TABLE 4.4

ANALYTICAL RESULTS OF SOIL BACKGROUND SAMPLE
MAIN BASE, EDWARDS AFB

Constituents	Concentration (mg/kg)	CAM* Criteria (mg/kg)
Cadmium	0.30	1
Chromium	6.1	5
Copper	3.6	25
Nickel	4.9	20
Silver	2.2	5
Zinc	25.9	250
Antimony	2.5	100
Arsenic	0.21	5
Lead	5.3	5
Mercury	0.034	0.2
Selenium	6.4	1
Aroclor 1254	0.02	-

*Levels requiring extraction to determine if the material is hazardous.

presence of these substances does not imply downward flow. Probably as long as conditions remain unchanged at the surface (cleaning the pond bottom or drying up the pond would be such a change), migration will not likely occur. Also since the water rose to 27 feet after the well was completed, it appears that some type of aquifer is present above the useful groundwater, which is apparently confined, further protecting the water from local infiltration of contaminated materials.

MAIN BASE - SITES 2 AND 3

Lysimeters were installed as previously discussed to determine potential for contamination of percolating runoff moving through the sites. At the time of installation, no water was present and no other soils analysis was made. No conclusions can be drawn. The lysimeters are to be checked by Base personnel; should water become present, it will be analyzed. Instructions for the use of the lysimeters are included as Appendix C.

BACKGROUND SAMPLE

The background surface soil sample was taken near the landfill (Site 3). The results of the analysis of this sample are presented in Table 4.4.

Table 4.5 lists the spectrum of pesticides and PCBs for which the sample was examined and the level of detectability used (EPA Method 608). Except for Aroclor 1254, a PCB, none of these were found. The CAM criteria for PCBs is 5 mg/kg; the level detected is insignificant compared to this criteria. The source of this trace of Aroclor 1254 is unknown.

It is interesting to note that chromium, lead, and selenium are all higher than the CAM criteria in the same level of magnitude as the soil sample taken at 15 feet near the industrial waste pond. This may infer the natural soils on the Base are higher than the CAM levels and thus the findings in Well 15 may be normal background.

TABLE 4.3

ANALYTICAL RESULTS OF SOIL
AND WATER SAMPLES FROM WELL 15
MAIN BASE, EDWARDS AFB

Constituents	Soil Samples Depth		CAM* Criteria (mg/kg)	Water (mg/l)	Federal Drinking Water Standards (mg/l)
	15 feet (mg/kg)	30 feet (mg/kg)			
Cadmium	0.65	0.21	1	<0.01	0.010
Chromium	11.3	1.7	5	0.05	0.05
Copper	6.7	0.95	25	<0.04	1.0
Nickel	9.5	2.1	20	0.15	-
Silver	4.9	2.9	5	0.012	0.05
Zinc	22.8	7.4	250	<0.04	5.0
Antimony	6.6	1.6	100	0.032	-
Arsenic	60.7	0.92	5	0.01	0.05
Lead	9.3	0.5	5	0.035	0.05
Mercury	0.14	0.017	0.2	<0.001	0.002
Selenium	9.7	1.0	1	0.008	0.01

*Levels requiring extraction to determine if the material is hazardous.

It can be concluded that lateral migration of chloroform and trichlorofluoromethane is considerably less than 200 feet from the disposal site.

MAIN BASE - SITE 8

Industrial wastes find there way to the pond at Site 8. In the IRP Phase II - Confirmation Study, the industrial waste pond was heavily laden with sediments containing significant quantities of a wide variety of metals. In order to determine whether or not these metals were migrating downward to the groundwater, a monitoring well (Well 15) was constructed down gradient from this pond. During drilling, soil samples were taken at 15 feet and 30 feet. Drilling continued to 45 feet. After drilling, water levels stabilized at 27 feet; soil samples were analyzed and a water sample was taken and analyzed. Table 4.3 gives the results of those analyses.

For comparative purposes, the Federal Drinking Water Standards and the California Assessment Manual (CAM) criteria for defining hazardous solid waste materials are also presented in Table 4.3. The CAM criteria have been developed to help deal with the problem of contaminated materials. They set levels below which the material is considered to be nonhazardous. Above the CAM criteria, the extraction test must be utilized to determine whether the offending substance is mobile or fixed, under the conditions of a standard extraction test.

For all the metals measured, the groundwater exhibits less than the level permitted by the Federal Standards for drinking water. At the time and place of sampling, no problem exists.

The soil samples in monitoring will show marginally high levels of chromium, arsenic, lead and selenium (see discussion of background sample). These levels do not pose an imminent health hazard; however, they do reflect a slight potential for groundwater contamination.

In ponds such as this, it is very likely that the initial use of the pond (when new), charged the underlying soils with the pond water. With time, the soils in the pond bottom clog and the outflow stops. The moisture held in the soil is retained and may then dry up leaving the offending metals behind as crystals. The important point is that the

10 mg/l. Since the value is low, it seems apparent that no continuous or recent migration of nitrate to the groundwater has or is occurring.

NORTH BASE - SHALLOW SOIL BORING

During the initial drilling and sampling in the proximity of Sites 1A, 1B, 1D1, and 1D2, chloroform and trichlorofluoromethane were found to be pervasive to the depths drilled (60 feet) at typical limits of 500 and 3,000 micrograms per kilogram, respectively. There was concern that these substances were migrating through the soil horizontally by gaseous diffusion. To test this hypothesis, three shallow borings (10 feet) were drilled around Site 1D1 at a distance of approximately 200 feet. Samples were carefully taken and analyzed (to minimize loss of gaseous substances). Analyses were performed for chloroform and trichlorofluoromethane at a detection level of 2.5 and 20 micrograms per kilogram, respectively; neither of these substances were detected. Soil samples from Well 12, the water monitoring well, were also taken at 10 and 20 feet. The sample at the 10-foot level showed chloroform at the level of detectability, 2.5 micrograms per kilogram. These results are shown in Table 4.2.

TABLE 4.2

RESULTS OF SOIL SAMPLE ANALYSES
NORTH BASE

Location	Concentration (µg/kg)	
	Chloroform[a]	Trichlorofluoromethane[b]
Bore 1 (10 feet)	<2.5	<10
Bore 2 (10 feet)	<2.5	<10
Bore 3 (10 feet)	<2.5	<10
Well 12 (10 feet)	2.5	<10
(20 feet)	<2.5	<10

[a]Detection limit 2.5 µg/kg
[b]Detection limit 10 µg/kg

CHAPTER 4

DISCUSSION OF RESULTS AND SIGNIFICANCE OF FINDINGS

NORTH BASE - GROUNDWATER MONITORING WELL

Table 4.1 presents the results of a nitrate analyses in the soil column at Well 12.

TABLE 4.1

RESULTS OF SOIL ANALYSES FROM WELL 12
NORTH BASE, SITE 1C, EDWARDS AFB

Depth (ft)	Nitrate Concentration (mg/kg)
10	0.77
20	0.20
45	0.19
55	0.30
65	0.33
103	0.34

Detection limit: 0.02 mg/kg.

In earlier borings (Phase II - Confirmation), slant borings directly under the nitric acid disposal pits revealed nitrates in the soil from 1,000 to 2,000 mg/kg. Here, a short distance away from the pit, there appears to be no notable nitrate concentrations. This would indicate that nitrate movement in the soil was essentially vertical and the area of soil contaminated is small though very deep.

A water sample of the underlying groundwater showed a concentration of .54 mg/kg. This is well below the Federal drinking water standard of

CHAPTER 4

DISCUSSION OF RESULTS AND SIGNIFICANCE OF FINDINGS

then lowered into the well, and the well water was evacuated. Water level data were collected during pumping of the well and during recovery to provide rough estimates on aquifer characteristics.

After the well had been pumped and allowed to recharge, it was sampled with a Teflon/quartz bailer. The sampler was only lowered to intercept the top of the water to allow for sampling of potentially floating hydrocarbons. The sample was transferred to VOA glass bottles, iced, and transported to the laboratory for analysis. EPA Method 8015 was used.

SOUTH BASE - WELL 9N9W-6E1

Well 6E1 is located north of Site 5 in an area that does not appear to be affected by or affecting Site 5. The U.S. Geological Survey uses Well 6E1 to monitor water levels in the area on an annual basis. Recordings from previous years by U.S.G.S. show identification of fuel smell in this well. The Base personnel collected a water sample from this well in 1982, at which time leaded fuel was found in the water sample. The well has never been in active use since its installation in 1942.

During the field program, carried out in August and September of 1983, Well 6E1 was sampled for visual evidence of petroleum products, none was identified. The well was then pumped in the same manner as Well MB-1, described above. Over 600 gallons of water was removed, in excess of 10 well casing volumes. The well was then allowed to recharge prior to sampling.

After pumping and recovery, the well was sampled with a Teflon/quartz bailer. The sample was only lowered to intercept the top of the water where the presence of floating hydrocarbons would be most noticeable. The sample was transferred to VOA [illegible] bottles, iced and transported to the laboratory for analysis. EPA Method 8015 was used.

transferred into acid-washed glass jars for metals analysis, and one portion was placed into a solvent-rinsed glass jar for pesticide and herbicide analyses. The method used for analysis consisted of acid digestion followed by atomic absorption spectrophotometry.

Pesticides and PCBs were analyzed using EPA Method 608, and herbicides were analyzed by soxhlet extraction followed by ASTM 509B for chlorinated phenoxyacid herbicides in water.

SOUTH BASE - MONITORING WELLS

Two groundwater monitoring wells were installed immediately down gradient from the underground POL tanks at Site 5 at the locations indicated. Well 13 is about 40 feet east of the fence surrounding the POL area, and about 400 feet south of the roadway. Well 14 is located about 400 feet to the east of Well 13 toward the lake bed. Both wells were constructed with hollow-stem auger drilling. The geologic logs and well completion summaries for both wells are contained in Appendix B.

Soil samples were collected by a split spoon sampler, and the sample was transferred to VOA glass bottles (25-ml glass vial with a Teflon-lined screw cap top), iced, and delivered to the laboratory for analyses for fuel. The analyses for fuels were completed using EPA test Method 8015 for evaluating solid waste for nonhalogenated volatile organics (by direct injection of a carbondisulfide extract), with a detection limit of 100 mg/kg for the soils, and 20 mg/kg for water.

SOUTH BASE - BASE WELL MB-1 (9N9W-6L1)

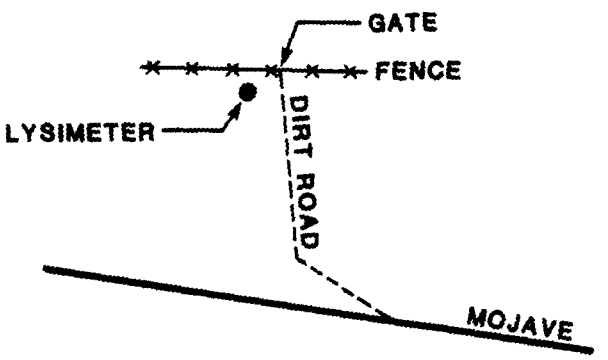
Main Base Well 1 (MB-1) is an old well that was found to contain an unknown contaminant (see IRP Phase II Stage 1 well log). The well is not currently in operation. It was constructed to a depth of 147 feet with perforations in the 14-inch casing at the interval 33 feet to 130 feet. The well is located down gradient from Site 5.

The well was sampled for presence of fuels. First, a Teflon/quartz bailer was used to preliminarily ascertain if any petroleum products were present on top of the water surface. There was no visual evidence of floating petroleum. A four-inch submersible stainless steel pump was

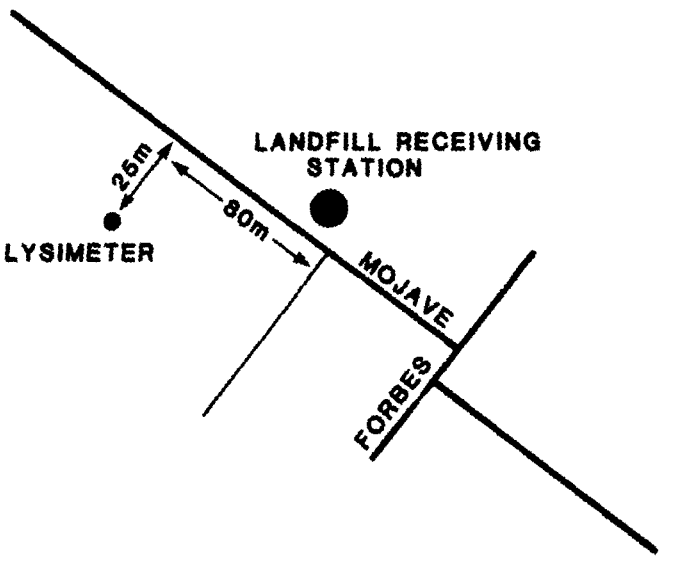
FIGURE 3.4

LOCATION OF LYSIMETERS AT SITES 2 AND 3
EDWARDS AFB

SITE 2



SITE 3



pumped and allowed to recharge. (See Appendix D for data.) The well was again sampled for evidence of fuels; none was found.

SUMMARY - SOUTH BASE

A layer of fuel-contaminated soil was found at about 45 feet below the surface. The layer extends at least 400 feet to the east of the tank. The contamination is heaviest near the tank (4,000 mg/kg). At 400 feet, the contamination is 300 mg/kg.

No evidence of groundwater contamination was found in the South Base area.

CHAPTER 5

ALTERNATIVE MEASURES

CHAPTER 5

ALTERNATIVE MEASURES

This report serves only to further confirm situations presented in the earlier Installation Restoration Program, Phase II - Confirmation report dated September 1982. That report presents alternative measures. The findings of this report do not affect those recommended alternative measures.

CHAPTER 6

RECOMMENDATIONS

CHAPTER 6

RECOMMENDATIONS

The supplemental Phase II field work completed in August and September of 1983 did not identify contamination of groundwater supplies at Edwards AFB at the locations of investigation.

RECOMMENDED MONITORING PROGRAM

It is recommended that a sampling program be established to monitor the groundwater quality in the area where the Phase II supplemental field work was completed. The recommended monitoring program is outlined in Table 6.1.

FURTHER STUDIES AT SITE 5

As a result of these investigations, it was determined that a layer of fuel-contaminated soil exists 45 feet below the ground surface extending horizontally at least 400 feet easterly of the POL tank at Site 5, South Base. Groundwater occurs approximately 20 feet below this layer.

The procedures used to analyze for fuels identified nonhalogenated volatile organics (EPA 8015). The main concern with such substances in water is in the area of taste and odor rendering the water nonpotable. Since the POL tanks held waste materials of unknown composition, the oily materials could contain substances of health concern. At this time, it appears that the oily contaminant is adsorbed to the soil matrix and thus remains suspended in the soil column. Should the water table rise and remobilize the oily materials, a problem could result.

Since, at this time, knowledge of the extent of the contaminated area, the expected variations in groundwater level and the potential

TABLE 6.1

RECOMMENDED MONITORING FOR THE PHASE II SUPPLEMENTARY WORK

Site	Pre-Sampling Preparation	Sampling Procedure	Constituents to be Identified in Analyses	Sampling Container	Sample Preservation	Sampling Frequency
North Base Well 12	Evacuate 4 well volumes from the well with a submersible pump. Use a Teflon tubing as discharge line from the pump.	Sample directly from discharge tubing into sampling bottle.	Nitrates	500-ml polyethylene bottle	1 ml of concentrated sulfuric acid. Place sample on ice.	Semiannually at regular intervals
Main Base Well 15	Same as for Well 12	Same as for Well 12	Cadmium, chromium, copper, nickel, silver, zinc, antimony, arsenic, lead, mercury, and selenium	1-l polyethylene acid-washed bottle	10 ml of concentrated nitric acid. Place sample on ice.	Semiannually at regular intervals
Lysimeter, Site 2	None	Evacuate the porous cup with pump.	Chromium, cyanide, tetraethyl lead	For chromium and tetraethyl lead: 500-ml polyethylene acid-washed bottle. For cyanide: 1-l polyethylene bottle.	5 ml of nitric acid. Place sample on ice. 1 pellet of sodium hydroxide. Place sample on ice.	Twice a year following major storm events
Lysimeter, Site 3	None	Same as for Site 2	Antimony, arsenic, cadmium, chromium, copper, lead, mercury, nickel, selenium, silver, zinc, pesticides and herbicides	For metals: 1-l acid-washed polyethylene bottle. For pesticides and herbicides: 2-l solvent-rinsed glass bottles w/ Teflon cap liners.	10 ml of concentrated nitric acid. Place sample on ice. Place sample on ice.	Twice a year following major storm events
South Base Wells 13 and 14 MB-1, 6E1	None	Lower bailer into wells to a depth where the sampler is intercepting the water table.	Fuels	2 VOA bottles	Place sample on ice.	Semiannually at regular intervals

presence of problem substances in the oily contaminant is limited, the following actions are recommended:

- Resistivity surveys should be conducted to estimate the areal extent of the contamination.
- A series of wells should be drilled to confirm the results of the resistivity surveys.
- Samples of the oily material should be taken while drilling the foregoing wells. The samples should be analyzed for potential problem contaminants. The contaminants to be considered for analysis should be determined based on Air Force information as to potential POL waste constituents.
- A water level monitoring program should be developed in the Site 5 area. The information obtained from this program will be useful in assessing the potential for migration of possible problem substances.

APPENDIX A

SCOPE OF WORK

APPENDIX A

SCOPE OF WORK

As a result of the investigation entitled Installation Restoration Program Phase II - Confirmation conducted at Edwards AFB, it was decided to perform certain additional explorations and investigations at the Base. The Air Force chose to administer these supplemental investigations utilizing a modification of the original contract documents. The scope of the original contract was modified to reflect this additional work. The following document is the modification of the original scope of work containing the desired modifications. The modifications covering this supplemental work are underlined for the convenience of the reader.

INSTALLATION RESTORATION PROGRAM
PHASE II FIELD EVALUATION
EDWARD AFB, CALIFORNIA

I. DESCRIPTION OF WORK

The purpose of this task is to determine the magnitude and extent of environmental contamination which has resulted from previous waste disposal practices at Edwards AFB, California; to make recommendations for actions necessary to mitigate adverse environmental effects of existing contamination problems; to suggest potential ways of restoring the environment to as near a normal level as is practical; and, to suggest a future environmental monitoring program to document environmental conditions at Edwards AFB.

The presurvey (Task Order 2) report incorporated background and description of the sites for this task. To accomplish this survey effort, the following steps will be taken:

A. Install one test hole downstream of the main toxic waste disposal area, Site 2. Perform analyses for toxic contaminants on two soil-moisture samples.

B. Install four groundwater monitoring wells, one well upgradient and three wells downgradient of the waste POL storage area, Site 5. Perform analyses for organic contaminants on eight water samples.

C. Monitor ambient air quality for total hydrocarbon at the sites described below after wells are installed.

D. Install a maximum of two monitoring wells downgradient from Sites 1B, C, and D. The wells will extend a maximum of 100 feet and consist of PVC, Schedule 40 casing, and screen. A maximum of eight in-place soil samples will be collected for analysis for nitrates, chloroform, and trichlorofluoromethane. Following well installation, the groundwater will be sampled for the same constituents.

E. Install test holes to remove subsurface soils for analysis as follows:

1. one hole slant-drilled at Site 1A,

2. one hole slant-drilled at the subsite south of the playa at Site 1B,

3. two slant holes (1 per subsite) at Site 1D, and

4. three soil samples from each hole above will be analyzed for organic contaminants.

5. three 10-foot deep soil borings drilled radially away from Sites 1B, C, and D; collect one soil sample per boring and analyze for chloroform and trichlorofluoromethane.

6. one boring each at sites 2 and 3, installed to bedrock; install a lysimeter in each boring.

F. Install one test hole in the center of the main nitric acid pit at Site 1C. Remove five samples and analyze for nitrates.

G. Collect two surface soil samples downslope of the abandoned sanitary landfill, Site 3. Analyze for organic contaminants and heavy metals.

H. Collect one liquid sample and four sediment samples from the industrial waste pond, Site 8. Analyze for toxic organic contaminants.

I. Collect one background surface soil sample and analyze for heavy metals, pesticides and herbicides.

J. Install five monitoring wells in the vicinity of Site 8. The wells shall be installed to define the plume originating from the pipeline break between Buildings 1635 and 1810, and pipeline leak at Building 1724. Analyze two samples from each well (10 samples total) for organic contaminants.

K. Install a maximum of two groundwater monitoring wells immediately downgradient from Site 8. Collect one water sample from each well and analyze for organic contaminants and heavy metals.

L. Redevelop abandoned South Base well 9E/9W-6B1 and collect a groundwater sample after 10 well volumes have been removed. The sample will be analyzed for the presence of fuels. A pump test will be conducted to ascertain aquifer characteristic estimates.

M. Install a maximum of two groundwater monitoring wells downgradient from Site 5. The design of the wells will be similar to that of the well in Item I.D above. A maximum of 11 soil samples will be collected and analyzed for presence of fuels. A maximum of two groundwater samples will be analyzed for fuels.

N. A maximum of four groundwater monitoring wells shall be installed during tasks described in Items I.D, I.K, and I.M. Total depth of wells installed shall be 400 linear feet. One groundwater sample per well shall be analyzed as described in the applicable Item.

O. Close all abandoned test wells and test holes from the above tasks in accordance with regulations of the California Water Quality Control Board.

P. A final report (Item VI below) will be prepared delineating the magnitude and extent of environmental contamination, to include recommendations required for cleanup or to mitigate the adverse effects of previous waste disposal practices. Recommendations for future environmental monitoring must also be included.

Q. A supplemental final report will be prepared after the completion of Items I.D, I.E.5, I.E.6, I.I, I.K, I.L, and I.M. Monitoring results and recommendations will be delineated as in Item I.P above.

II. SITE LOCATION AND DATE:

Edwards AFB CA
Building 3925

N/A

III. BASE SUPPORT: None

IV. GOVERNMENT FURNISHED PROPERTY: None

V. GOVERNMENT POINTS OF CONTACT:

1. Dr Dee Ann Sanders
USAF OEHL/ECQ
Brooks AFB TX 78235
(512) 536-3305

2. Mr James Baker
USAF Hospital Edwards/SGPA
Edwards AFB CA 93525
(805) 227-3272/2982

3. Capt Richard Brewer
HQ AFSC/SGPB
Andrews AFB MD 20334
(301) 981-5235

VI. In addition to sequence numbers 1, 6 and 11 listed in Atch 1 to the contract which are applicable to all orders, the sequence number listed below is applicable to this order:

Sequence No.	Block 10	Block 11	Block 12	Block 13
4	One/R	83 Dec 10	83 Dec 31	84 Mar 30

*Twenty-five (25) copies of the Draft Supplemental Final Report are required. Fifty (50) copies plus the camera-ready of the Supplemental Final Report are required.

APPENDIX B

WELL LOGS

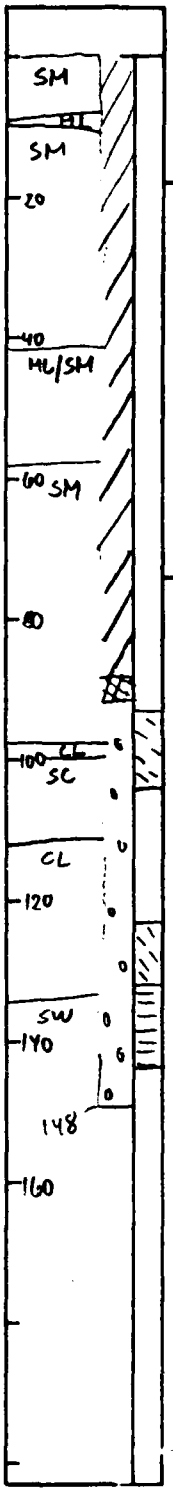
WELL 12

WELL CONSTRUCTION SUMMARY

LOCATION or COORDS: Northbase site 1C

ELEVATION: GROUND LEVEL –

TOP OF CASING –



LOCATION Northbase

PERSONNEL YU, ES

PROJECT IRP, Phase II

DRILLING SUMMARY:

TOTAL DEPTH 148'

BOREHOLE DIAMETER 8"

DRILLER Stang Hydronics, Orange CA

RIG Mobile B-53

BIT(S) Auger and roller bit (hollow stem auger + rotary wash)

DRILLING FLUID Super Gel-X (Bentonite)

SURFACE CASING Black iron

WELL DESIGN:

BASIS: GEOLOGIC LOG X GEOPHYSICAL LOG ___

CASING STRING(S): C=CASING S=SCREEN

0 - 94	C_1		94 - 104	S_1	
104 - 124	C_2		124 - 134	S_2	
			134 - 144	S_3	

CASING: C1 4" PVC, SCH 40

C2 4" PVC, SCH 40

C3 ___

C4 ___

SCREEN: S1 4" PVC, SCH 40, Handslotted

S2 4" PVC, SCH 40, Handslotted

S3 4" St. steel, 10 slots

S4 ___

CENTRALIZERS –

FILTER MATERIAL gravel 148'-93'

CEMENT 89'-0

OTHER Bentonite pellets 93'-89'

CONSTRUCTION TIME LOG:

TASK	START DATE	START TIME	FINISH DATE	FINISH TIME
DRILLING: Augering	8/9/83		8/31/83	
Rotary	9/9		9/10	
GEOPHYS. LOGGING:	–	–	–	–
CASING.	9/10			
FILTER PLACEMENT:	9/11			
CEMENTING:	9/11			
DEVELOPMENT:	9/12			
OTHER:				

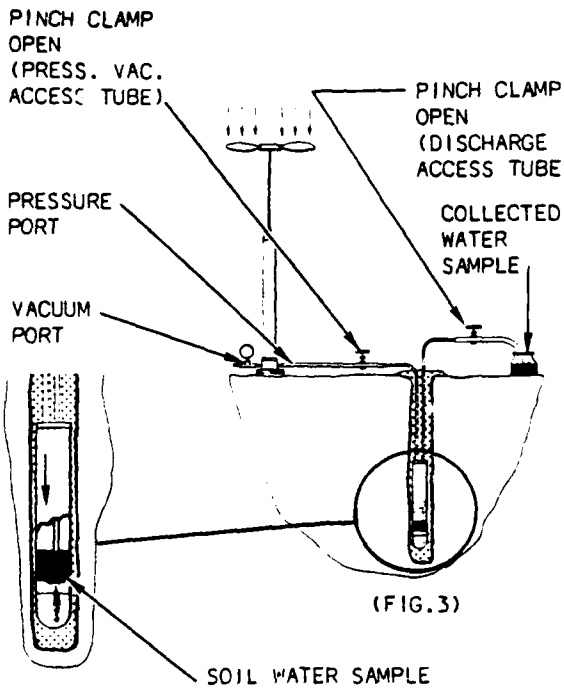
WELL DEVELOPMENT

Bailing

COMMENTS:

The augering caused rig to overheat every 10'. Cuttings not coming up after 30' had to pull augers every 10' to clean out. After 103', switched to rotary wash wet clay layer @ 97'. Aquifer at 135' w/ wtr. level rising to ≈ 100'

Samples @ 10', 20', 45', 55', 65', and 103' w/ Cal. modified



(FIG.3)

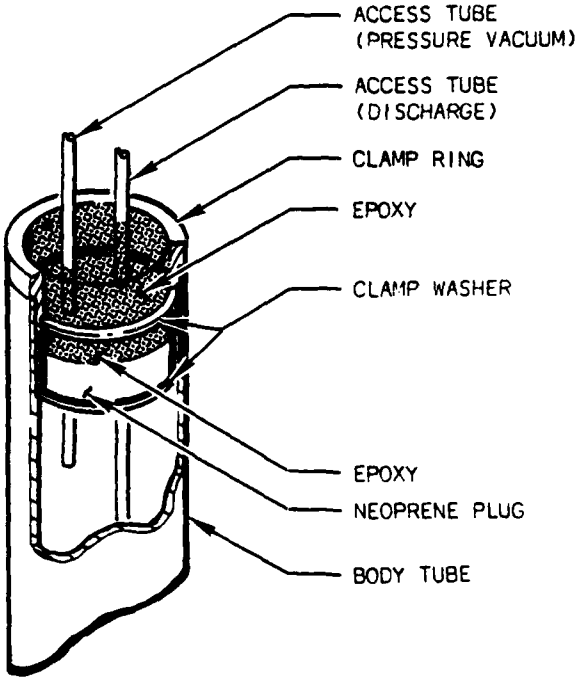
(Fig.3) To recover a soil water sample, attach the pressure-vacuum access tube to the pressure port on the pump. Place the discharge access tube in a small collection bottle and open both pinch clamps. Apply a few strokes on the hand pump to develop enough pressure within the sampler to force the collected water out of the sampler and into the collection bottle.

Subsequent samples are collected by again creating a vacuum within the sampler and following the steps as outlined above.

MAINTENANCE

There are no maintenance requirements for the pressure-vacuum soil water samplers, other than protecting the access tubes from damage. Tube ends should be covered or plugged to prevent debris from entering the tubes and later contaminating the sample.

Freezing conditions will not damage the samplers. The samplers are normally left permanently in place throughout the year.



INSTRUCTIONS FOR POTTING

With our current design, we do not feel that potting of the neoprene plug is necessary to maintain a permanent pressure-vacuum seal; however, if you desire, the design has been arranged so that these elements can be potted with an epoxy resin.

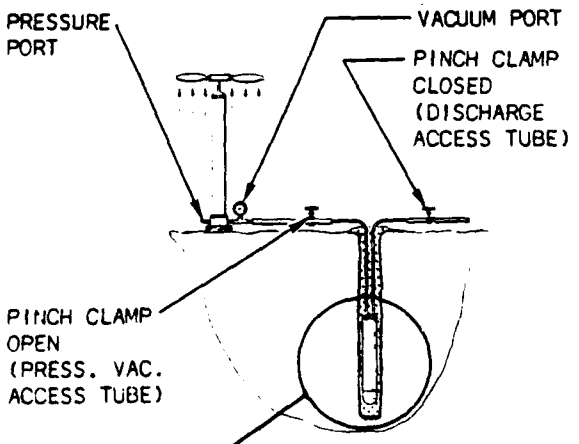
(1) INSTALL ACCESS TUBES

(2) INSTALL FIRST CLAMP WASHER

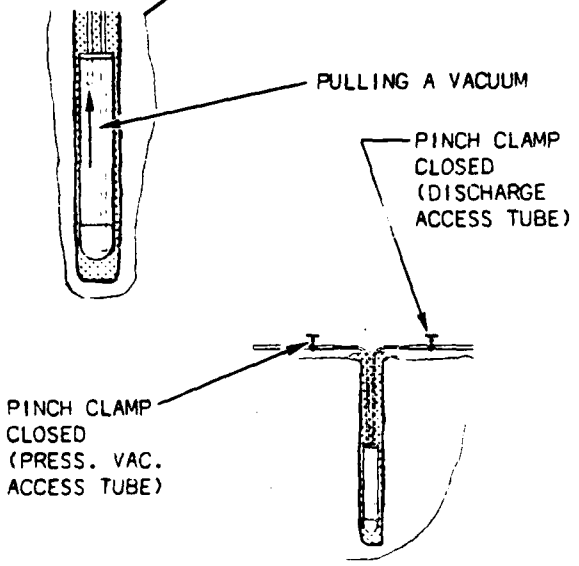
(3) INSTALL NEOPRENE PLUG AND ADD EPOXY TO THE OUTSIDE DIAMETER

(4) INSTALL SECOND CLAMP WASHER

(5) SCREW CLAMP RING IN PLACE, AND POUR EPOXY INTO CAVITY TO COMPLETELY SEAL THE NEOPRENE PLUG AND ACCESS TUBES



(FIG.1)



(FIG.2)

COLLECTING SOIL WATER SAMPLE

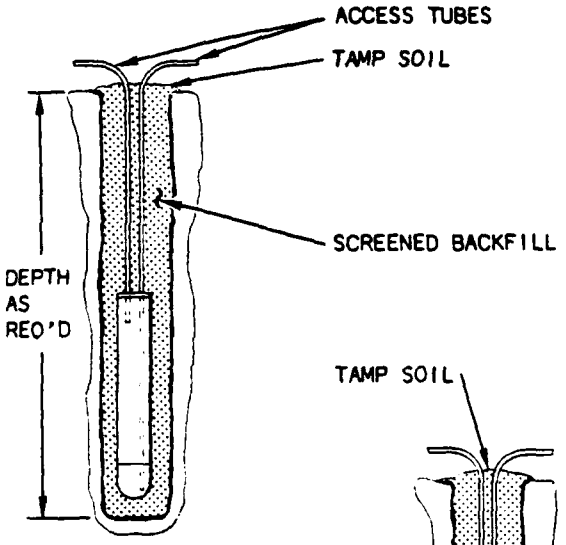
After the pressure-vacuum soil water sampler has been installed in the field, the accessory items are added as shown on page 6 .

(Fig.1) To collect a sample, the pinch clamp on the discharge access tube is closed and the vacuum port of the pressure-vacuum hand pump is connected to the pressure-vacuum access tube. The pump is then stroked until a vacuum of perhaps 60 centibars (18" of mercury) is created within the sampler, as read out on the gauge connected to the pump.

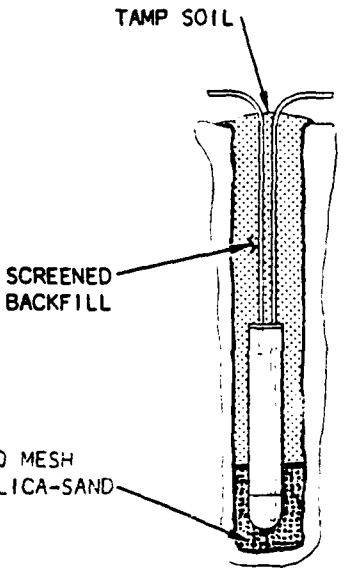
(Fig.2) The pinch clamp on the pressure-vacuum access tube is then closed securely to seal the sampler under vacuum. The hand pump can then be removed for other uses. The sampler is allowed to set for a period of time under vacuum.

The vacuum within the sampler causes the moisture to move from the soil, through the porous ceramic cup, and into the sampler. The rate at which the soil solution will collect within the sampler depends on the capillary conductivity of the soil, the soil suction value within the soil (as measured with tensiometers), and the amount of vacuum that has been created within the sampler. In moist soils of good conductivity, at field capacity (10 to 30 centibars of soil suction as read on a tensiometer) substantial soil water samples can be collected within a few hours. Under more difficult conditions it may require several days to collect an adequate sample.

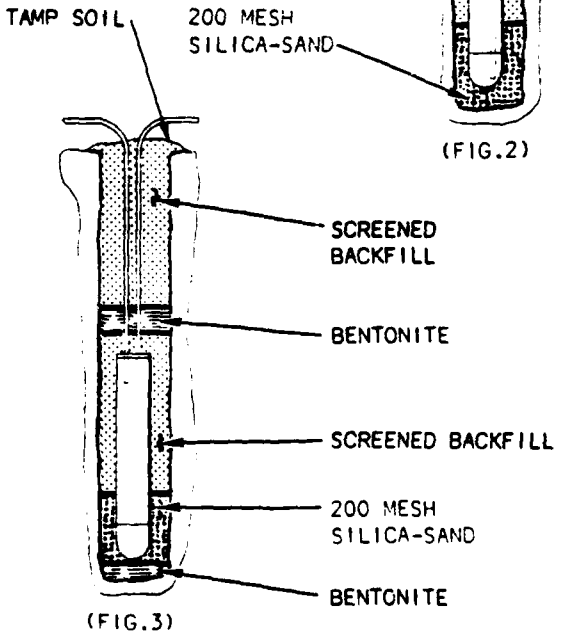
In general, vacuums of 50 to 8[illegible] centibars (15" to 25" of mercury) are normally applied to the soil water sampler. In very sandy soils it has been noted, however, that very high vacuums applied to the soil water sampler seem to result in slower rate of collection of the sample than lower applied vacuums. It is our feeling that in these coarse, sandy soils, the high vacuums within the sampler may deplete the moisture in the immediate vicinity of the porous ceramic cup and hence reduce the capillary conductivity, which creates a barrier to the flow of moisture to the cup under these circumstances. In loams and gravelly clay loams, users have reported collection of 300 to 500 ml of solution over a period of a day with applied vacuum of 15" of mercury (50 centibars) when soils are at field capacity. On waste water disposal sites, some users have obtained up to 1500 ml of sample within 24 hours after cessation of irrigation with 1" to 2" of waste water on sandy or clay loam soil.



(FIG.1)



(FIG.2)



(FIG.3)

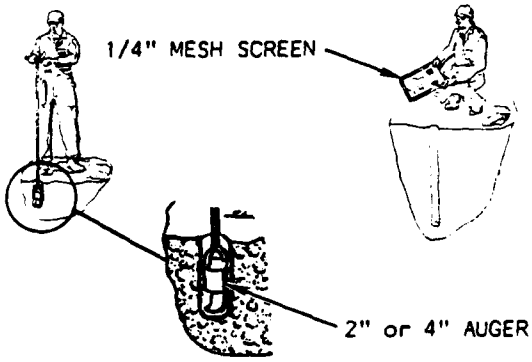
ADDITIONAL METHODS OF INSTALLING THE PRESSURE-VACUUM SAMPLER

(Fig.1) Core hole to desired depth, insert soil water sampler and backfill the hole with native soil, tamping continuously to insure good soil contact with the porous ceramic cup and complete sealing of the cored hole.

(Fig.2) Core hole to desired depth, pour in a small quantity of crushed 200 mesh pure silica-sand of almost talcum powder consistency (commercially available under trade names of Super-Sil and Silica Flour). Insert soil water sampler and pour another layer of the 200 mesh silica-sand at least six inches deep around cup of the soil water sampler. Backfill the hole with soil free of pebbles and rocks, tamping continuously with a long metal rod to insure against surface water channeling down between the soil and the body tube of the sampler.

(Fig.3) Core hole to desired depth, pour in a small quantity of wet bentonite clay. This will isolate the sampler from the soil below. Pour in a small quantity of 200 mesh silica-sand and insert soil water sampler. Pour another layer of 200 mesh silica-sand at least six inches deep around the cup of the soil water sampler. Backfill with native soil to a level just above the soil water sampler and again add a small quantity of bentonite as a plug, to further isolate the soil water sampler and guard against possible channeling of water down the hole. Backfill the remainder of the hole slowly, tamping continuously with a long metal rod. Again backfill should be of native soil free of pebbles and rocks.

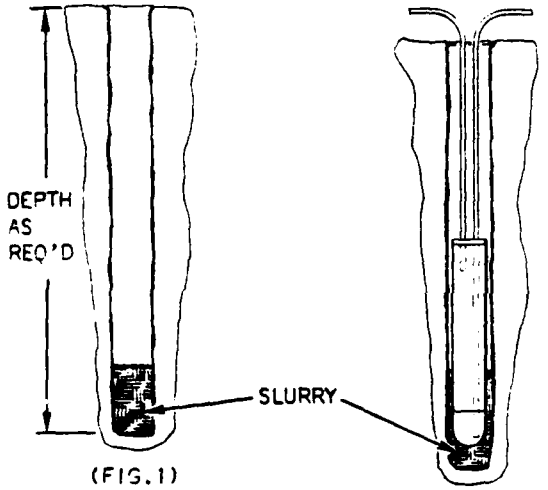
There are other methods of installing the soil water samplers that may be used, largely dictated by the type of soil you are concerned with and the tools available. The primary concern in any method of installation is that the porous ceramic cup of the sampler be in tight, intimate contact with the soil, so that soil moisture can move readily from the pores of the soil through the pores in the ceramic cup and into the soil water sampler.



CORING THE HOLE

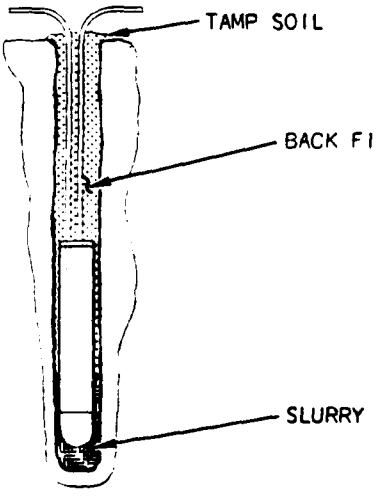
In rock-free uniform soils at shallow depths, use a 2" screw or bucket auger for coring the hole.

If the soil is rocky, a 4" auger should be used. The soil should then be sifted through a 1/4" mesh screen to free it of pebbles and rocks. This will provide a reasonably uniform backfill soil for filling in around the soil water sampler. The Model 230 Series Soil Augers can be used for this purpose.



(FIG.1)

(FIG.2)



(FIG.3)

INSTALLATION OF PRESSURE-VACUUM SOIL WATER SAMPLER USING A SOIL SLURRY

(Fig.1) After the hole has been cored, mix a substantial quantity of soil from the bottom of the hole with water to make a slurry which has a consistency of cement mortar. This slurry is then poured down to the bottom of the cored hole to insure a good soil contact with the porous ceramic cup.

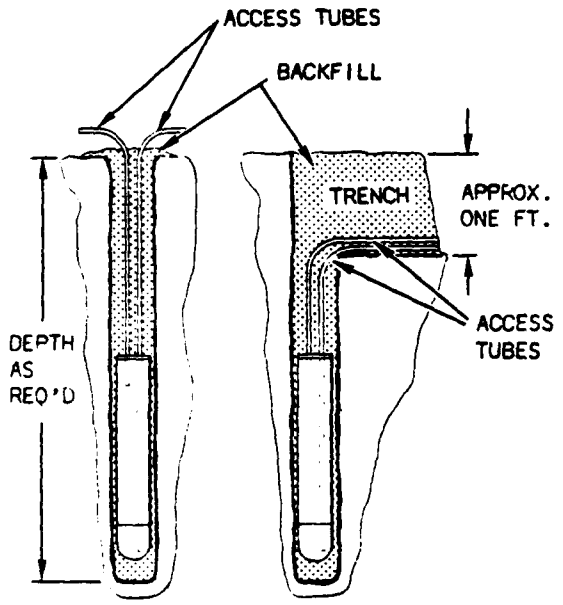
(Fig.2) Immediately after the slurry has been poured, push the soil water sampler down into the hole so that the porous ceramic cup is completely embedded in the soil slurry.

(Fig.3) Backfill the remaining area around the soil water sampler, tamping lightly with a small diameter rod. Backfill the remainder of the hole, tamping soil firmly, to prevent surface water from running down the cored hole. Backfill hole with native soil free of pebbles and rocks.

OPERATING INSTRUCTIONS for the

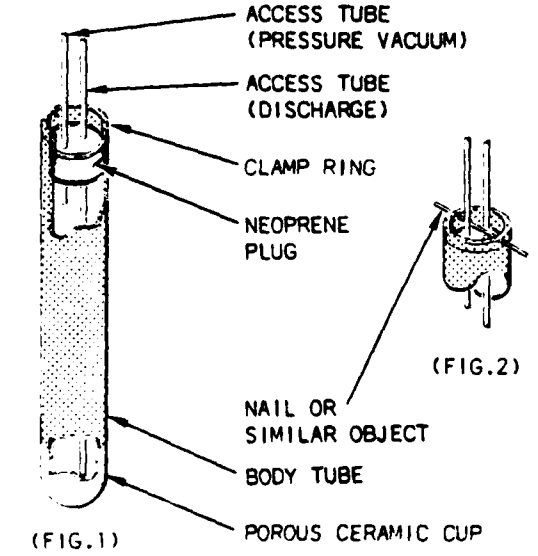
Model 1920

PRESSURE-VACUUM SOIL WATER SAMPLER



SITE LOCATION

The Model 1920 Pressure-Vacuum Soil Water Sampler can be installed in any location, at any depth up to a maximum of 50 ft. The access tubes from the sampler may be terminated directly above the sampler installation or, if conditions require, the access tubes may be laid in a trench and carried to a remote location, terminated above the soil surface. The access tubes should be located so that they will be free from damage by mechanical equipment and by livestock. The surface area directly above the sampler should not be covered in any manner that would interfere with the normal percolation of soil moisture down to the depth of the sampler. Once the depth and location for the pressure-vacuum soil water sampler has been decided, the length of the access tubes should be determined so that they can be cut and mounted into the soil water sampler.



(FIG.1)

(FIG.2)

INSTALLATION OF ACCESS TUBES IN THE SAMPLER

(Fig.1) The access tubes are normally made from 1/4" diameter copper or polyethylene tubing. When installing the tubes, one tube should be pushed through the neoprene plug so that the end of the tubing reaches almost down to the bottom of the porous ceramic cup. This "discharge" access tube should be marked at the other end in some fashion as to identify it. The other "pressure-vacuum" access tube should be inserted into the neoprene plug so that it extends through the plug perhaps one inch.

(Fig.2) After the tubes are installed, tighten the clamp ring with a nail or similar object inserted through the holes provided in the clamp ring. Tighten only until it meets the body tube. See note on page 5 if potting is desired.

APPENDIX C

LYSIMETER OPERATING INSTRUCTIONS

ES DRILLING LOG

Well No.: 15

Date: 8/17/83

Location: Edwards Industrial Waste Pond Altitude (Datum):

Method: Hollow stem Auger Size of hole: 8" Size of casing 4"

Driller: Stang Hydronics

DEPTH	TIME	DESCRIPTION	GRAPHIC LOG	COMMENTS
		Rd-brn sandy (20%) gravel, moist	GP	
		Rd fine-coarse sand, very moist, occasional gravel	SP	increasing wd sand decreasing moisture
10				
15				strata of alluvial
		Brn coarse sandy (20%) clay damp	CL	
20		Brn thin clayey sand	SC	damp
		tan clayey (10%) gravelly (10%) coarse sand moist	SP	
		sandy (10%) clay	CL	3' of running wet clayey
		Brn tan sand coarse, wet occasional gravel		
				hard drilling
40				
				T.D. 45'
50				
60				

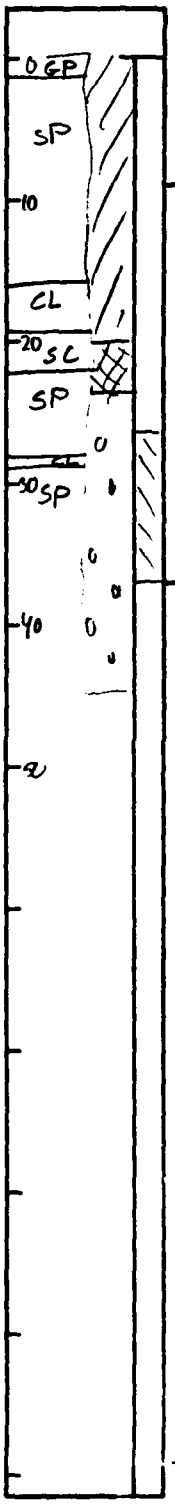
WELL 15

WELL CONSTRUCTION SUMMARY

LOCATION or COORDS: Edwards Industrial Waste pond site 8

ELEVATION: GROUND LEVEL _____

TOP OF CASING _____



LOCATION Edwards, Site 8

PERSONNEL YW, ES

PROJECT JRP Phase II

DRILLING SUMMARY:

TOTAL DEPTH 45'

BOREHOLE DIAMETER 8"

DRILLER Stang Hydronics

RIG Mobile B-53

BIT(S) Nigh and Rotary wash

DRILLING FLUID none

SURFACE CASING _____

CONSTRUCTION TIME LOG:

TASK	START DATE	START TIME	FINISH DATE	FINISH TIME
DRILLING:				
0-45	8/17	9:00	8/17	10:16
33-45	8/19	9:00	8/19	10:30
0-45	8/19	14:00	8/19	15:20
GEOPHYS. LOGGING:				
CASING:				
FILTER PLACEMENT:				
CEMENTING:				
DEVELOPMENT:				
OTHER:				

WELL DESIGN:

BASIS: GEOLOGIC LOG X GEOPHYSICAL LOG ___

CASING STRINGS(S): C=CASING S=SCREEN

26	36	S			
0	26	C			

CASING: C1 4" PVC, SCH40, threaded

C2 _____

C3 _____

C4 _____

SCREEN: S1 4" S. Steel, SCH40, threaded

S2 _____

S3 _____

S4 _____

CENTRALIZERS _____

FILTER MATERIAL sand 37-23'

CEMENT 0-20

OTHER bentonite 23-20

WELL DEVELOPMENT

COMMENTS:

Heavy rain 8/15 and 8/16
Wtr. after drilling 27', 20' of
augers pulled out
Hole caved to 33'
8/19 reamed to 45', put
bentonite down hole to
keep open, hole caved to 30'
Rotary to 37'

ES DRILLING LOG

Well No.: 14

Date: 8/16/1983

Location: Edwards, South Base, Site 5 Altitude (Datum): —

Method: Hollow Stem Auger Size of hole: 8" Size of casing: 4"

Driller: Stang Hydronics, Orange

DEPTH	TIME	DESCRIPTION	GRAPHIC LOG	COMMENTS
		Brn-tan silty (15%), clayey (5%) fn sand	SC	
			▽	wet, perched water table
				alkalis
10		silty coarse sand	SM	
				Alkalis
				moist, increasing coarse sand, occasional gravel
20				
		Rd-brn fn-md sand		25% silt
30				rounded
		white-tan coarse sand dry	SW	
40		Rd silty (10%) clayey (10%)	SM	
		mod-coarse sand		occasional gravel
45		Rd silt, coarse sand		increasing clay
				Fluid sample, water
50				
				increasing clay
60			T.D. 65'	

WELL 14

WELL CONSTRUCTION SUMMARY

LOCATION or COORDS: Edwards South Base, Site 5

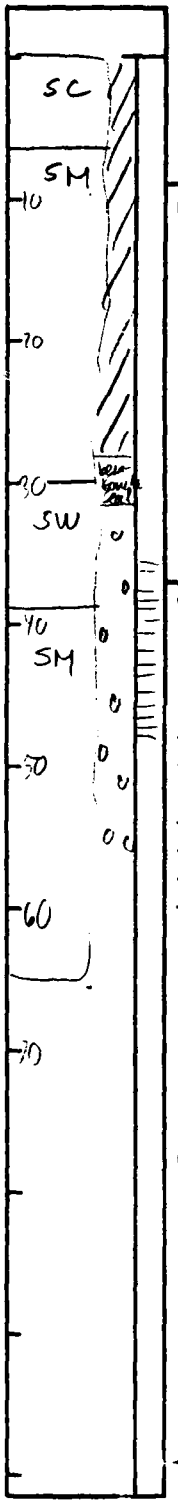
ELEVATION: GROUND LEVEL _____

TOP OF CASING _____

PROJECT IRP Phase II

LOCATION Edwards South Base

PERSONNEL YU, ES



DRILLING SUMMARY:

TOTAL DEPTH 65'

BOREHOLE DIAMETER 8"

DRILLER Stang Hydraulics

RIG Mobile B-53

BIT(S) auger

DRILLING FLUID none

SURFACE CASING metal cap

WELL DESIGN:

BASIS: GEOLOGIC LOG X GEOPHYSICAL LOG ___

CASING STRING(S): C=CASING S=SCREEN

36	46	S			
36	13.0	C			

CASING: C1 4" PVC, SCH 40, threaded

C2

C3

C4

SCREEN: S1 4" St Steel, 10 slots, threaded

S2

S3

S4

CENTRALIZERS

FILTER MATERIAL 10/20 sand 47-34

CEMENT Portland cement grout 34-0

OTHER bentonite seal, pellets 13-0

CONSTRUCTION TIME LOG:

TASK	START DATE	START TIME	FINISH DATE	FINISH TIME
DRILLING: 0-40	8/16	7	8/16	8:30
40-65	8/16	11:0	8/17	12:0
GEOPHYS. LOGGING:				
CASING:	8/16	14:2	8/16	14:2
FILTER PLACEMENT:	8/16	14:30	8/16	14:35
CEMENTING:	8/16		8/16	
DEVELOPMENT:	8/17			
OTHER: Equipment				

WELL DEVELOPMENT

COMMENTS:

At 4' a wet layer

At 10' ...

T.D. 65', caved to 57'

▼ 41' on Level after drilling

▽ 42 after auger

Z 45' 8/17, 7:00 a.m.

ES DRILLING LOG

Well No.: 13

Date: 8/14/83

Location: Edwards South Base, Site 5 Altitude (Datum):

Method: Hollow stem auger Size of hole: 8" Size of casing: 4"

Driller: Stang Hydronics

DEPTH	TIME	DESCRIPTION	GRAPHIC LOG	COMMENTS
		Rd org fn sandy (30%) silt	ML	
7		Lgt brn silty (10%) med-coarse sand	SM	
10				coarse sand increasing
17		Tan-brn silty (5%) coarse sndy (25%) gravel	GM	moist, granitic fragments alkalis
20		Brn-tan silty (5%) med-coarse sand	SM	
				fuel smell, streaks of alkalis
		Brn fn sndy clay	CL	
				fuel smell, moist
30		Rd-brn silty (5%) coarse sand, occasional gravel		
				fuel smell, moist, increasing silt
40		Rd-brn silty (10%) sndy (50%) gravel	GM	occasional clay
		silty coarse sand	SM	fuel smell, occasional gravel
50		Brn coarse sndy (5%) clay	CL	moist, fuel smell, increasing sand
		brn clayey (30%) med. sand	SC	
			T.D. (55')	-

WELL 13

WELL CONSTRUCTION SUMMARY

LOCATION or COORDS: Edwards South Base

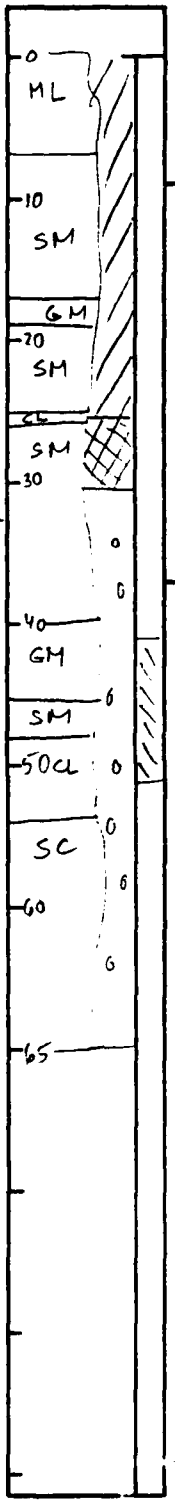
ELEVATION: GROUND LEVEL _____

TOP OF CASING _____

PROJECT IRP Phase II

LOCATION Edwards, Site 5

PERSONNEL YN, ES



DRILLING SUMMARY:

TOTAL DEPTH 65'

BOREHOLE DIAMETER 8"

DRILLER Stang Hydronics Orange, CA

RIG Mobile B-53, Hollow stem

BIT(S) Auger

DRILLING FLUID none

SURFACE CASING black iron

WELL DESIGN:

BASIS: GEOLOGIC LOG X GEOPHYSICAL LOG ___

CASING STRING(S): C=CASING S=SCREEN

+1 -	41	C_1	41 -	51	S_1
___ -	___	___	___ -	___	___
___ -	___	___	___ -	___	___
___ -	___	___	___ -	___	___
___ -	___	___	___ -	___	___
___ -	___	___	___ -	___	___
___ -	___	___	___ -	___	___
___ -	___	___	___ -	___	___

CASING: C1 4" PVC SCH 40 Threaded

C2 _____

C3 _____

C4 _____

SCREEN: S1 4" St. Steel, 10 slots

S2 _____

S3 _____

S4 _____

CENTRALIZERS —

FILTER MATERIAL 10/20 Lonestar Sand 30-51'

CEMENT 0-26'

1 part bentonite 1 part neat cement

OTHER Bentonite ~ 26-30'

CONSTRUCTION TIME LOG:

TASK	START DATE	START TIME	FINISH DATE	FINISH TIME
DRILLING: 0-47'	8/14	12:30	8/14	14:10
47-65	8/15	7:40	8/15	8:45
GEOPHYS. LOGGING:				
CASING:	8/15	11:30	8/15	1:45
FILTER PLACEMENT:	8/15	11:45	8/15	12:00
CEMENTING:	8/15	12:05	8/15	13:45
DEVELOPMENT:	8/17	15:55	8/17	16:20
OTHER:				

WELL DEVELOPMENT

Bailing

COMMENTS:

At 47' no groundwater encountered

wtr. level after drilling 41'

samples at 20', 30', 40', 45' w/ Cal. recovered

ES DRILLING LOG

Well No.: 12

Date: 8/9 - 9/9 1983

Location: Northbase, Site IC Altitude (Datum):

Method: Size of hole: Size of casing:

Driller:

DEPTH	TIME	DESCRIPTION	GRAPHIC LOG	COMMENTS
135			▽ SW	
140		Brn-tan well graded coarse sand		
			T.D. 148'	
160				

ES DRILLING LOG

Well No.: 12

Date: 8/9 - 9/9 1983

Location: Northbase, Site 1C

Altitude (Datum):

Method: Hollow Stem Auger
Rotary Wash

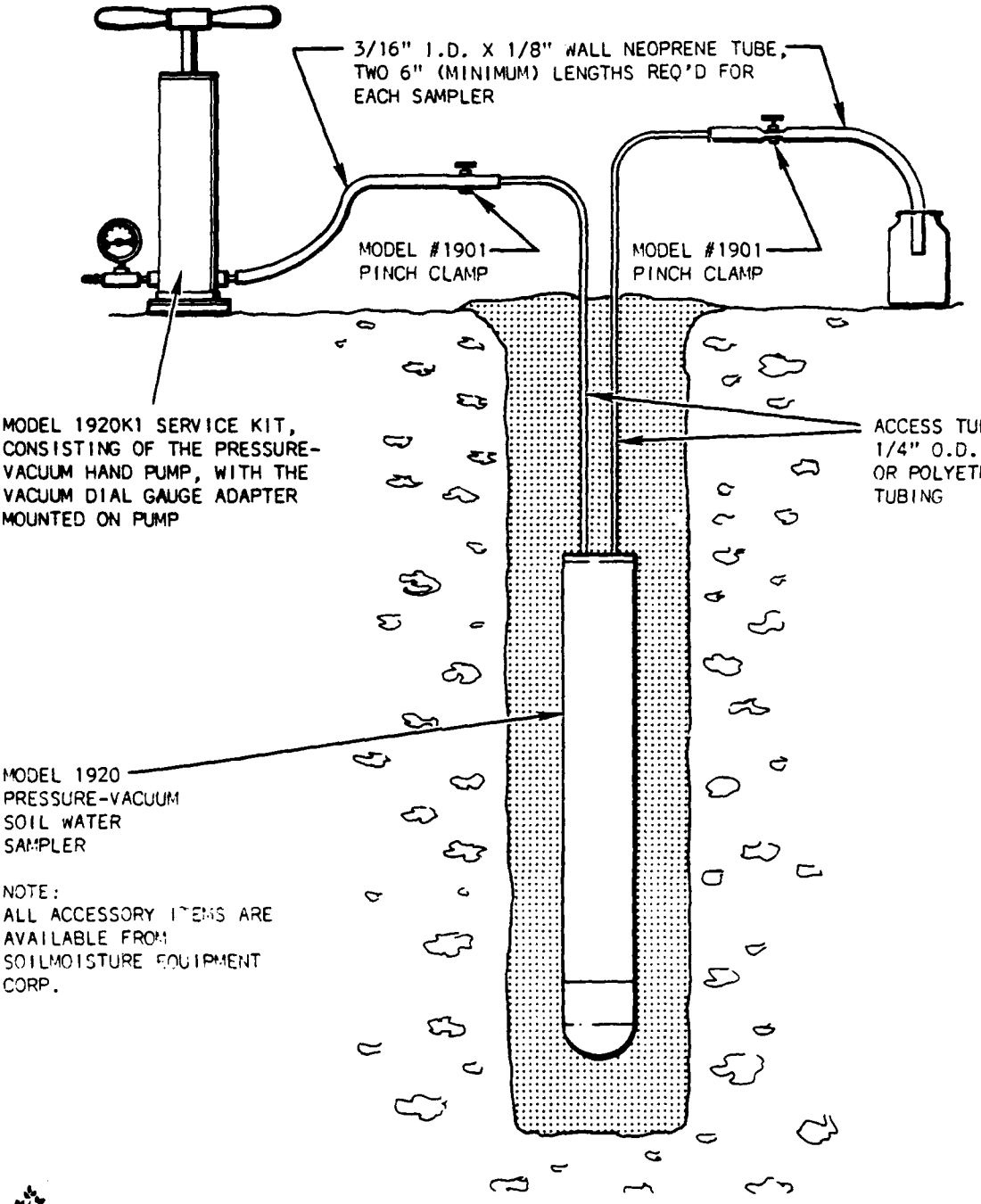
Size of hole: 8"

Size of casing: 4"

Driller: Stang Hydronics, Orauge CA

DEPTH	TIME	DESCRIPTION	GRAPHIC LOG	COMMENTS
4		lt brn med-coarse silty	SM	
8		(<5%) fn sand, dry		Alkalis
12		lt tan silt, dry	ML	Alkalis
16		Tan silty sand, dry	SM	Alkalis
20				
40				
		Brn. tan fine sandy silt dry	ML/SM	silt encrusted alkalis extremely hard pebbles
60		Lgt brn silty fn sand	SM	<5% coarse sand
				occasional wet sand
80				coarse white alkali nodules moist tip of auger increasing clay
100		brn sandy clay, wet	CL	<50% coarse sand
		brn clayey coarse sand	SC	moist
		Brn sandy (15%) clay	CL	moist
120				

ACCESSORY ITEMS REQUIRED FOR OPERATION OF THE PRESSURE-VACUUM SOIL WATER SAMPLER



NOTE:
ALL ACCESSORY ITEMS ARE AVAILABLE FROM SOILMOISTURE EQUIPMENT CORP.

Soilmoisture Equipment Corp. P.O. Box 30025, Santa Barbara, Calif. 93105 U.S.A.

APPENDIX D

WELL PUMPING FIELD DATA AND FIELD PLOTS

AQUIFER TESTING DATA

PROJECT NAME Edwards AFB — RECOVERY x

project # 26339 well # MB-1 (9N9W 6L1) — PUMPING x

location South Base, site 5

formation tested Shallow aquifer ground elevation 2,282.26' elevation of casing —

distance from test well NA depth of well 147', 14" dia screen interval 33-130 ft

date test began 8/16/1983 time test began 12:21 p.m.

water level indicator slope indicator

$Q = 3.2$ gpm

$h_o = 47.70$

TIME	T.O.C. DEPTH TO WATER (ft)	DRAWDOWN (residual) (ft)	ELAPSED TIME (min)	$t/t' = \frac{t'+82}{t'}$	REMARKS
					t' = time since pumping stopped
12:00	47.70				~~before~~ pump installed
12:13	47.70				pump installed
12:21	47.75	0.05	0.5		no apparent fuel on water surface
12:31	47.94	0.24	10.0		
12:41	47.96	0.26	20.0		no odor
12:51	47.96	0.26	30.0		
13:01	47.98	0.28	40.0		
13:11	47.98	0.28	60.0		
13:33			82.0		Engine out of gas
		$h_o - h'$			
13:33:30	47.88	0.18	82.8	103.5	
13:34	47.83	0.13	83.0	83.0	
13:35	47.79	0.09	84.0	42.0	
13:35:30	47.77	0.07	84.5	33.8	
13:36	47.75	0.05	85.0	28.3	
13:38	47.73	0.03	87.0	17.4	
13:39	47.72	0.02	88.0	14.7	
13:41	47.72	0.02	90.0	11.3	
					1 casing volume:
					$\pi r^2 = (147-47.70)\pi(2/12)^2$
					= 112 gal

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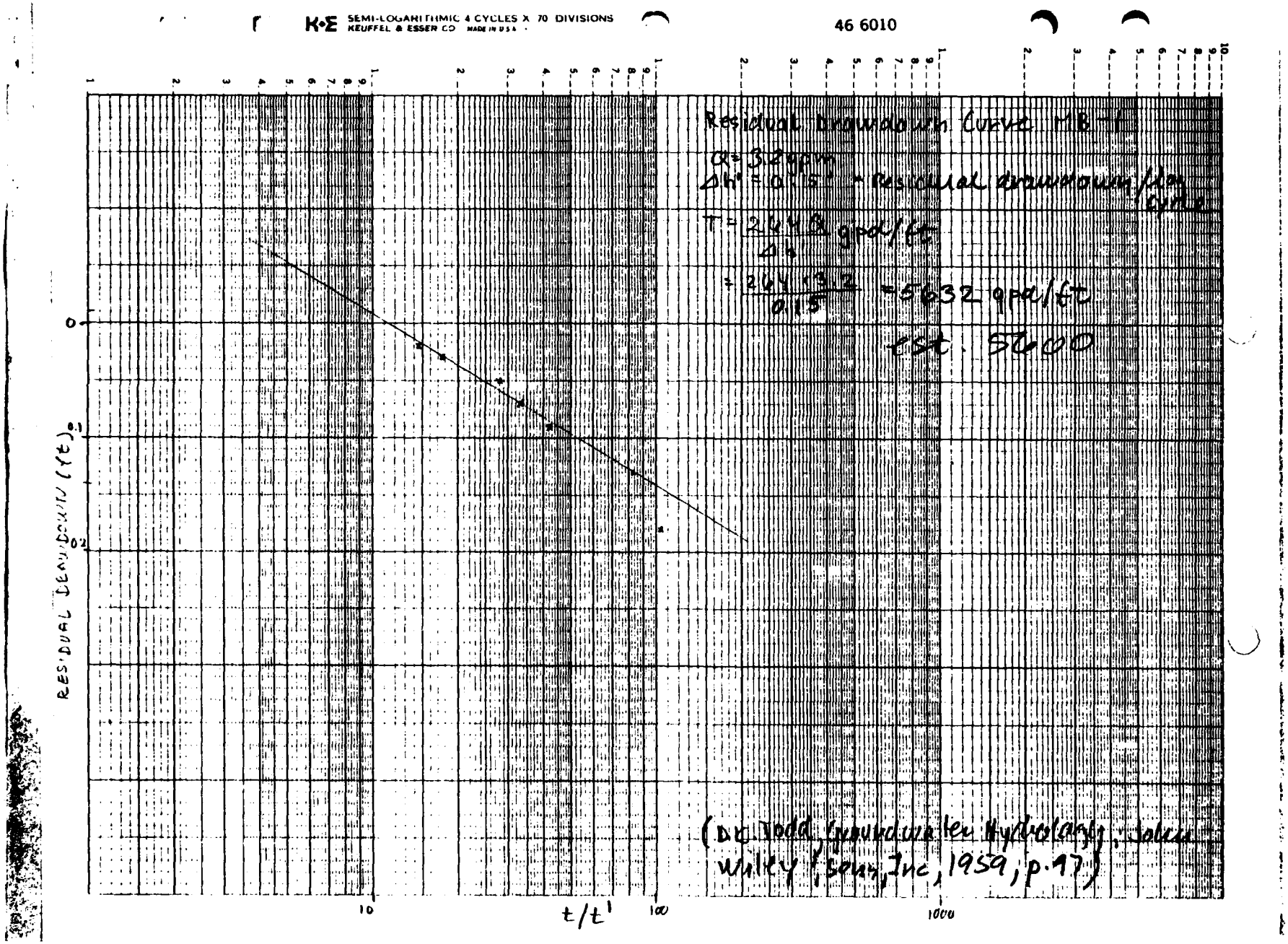
K•E SEMI-LOGARITHMIC 4 CYCLES X 70 DIVISIONS
KEUFFEL & ESSER CO MADE IN U.S.A.
46 6010
Residual Drawdown Curve MB-1
Q = 3.2 gpm
Δh' = 0.15' = residual drawdown/log cycle
T = 264 Q / Δh
= 264 x 3.2 / 0.15 = 5632 gpd/ft
est. 5600
(D.K. Todd, Groundwater Hydrology; John Wiley & Sons, Inc, 1959, p. 97)
RESIDUAL DRAWDOWN (ft)
0
0.1
0.2
10
t/t'
100
1000

AQUIFER TESTING DATA

PROJECT NAME Edwards AFB — RECOVERY ___

project # 26339 well # 6E1 — PUMPING X

location South base

formation tested shallow aquifer ground elevation 2,290.25' elevation of casing —

distance from test well NA depth of well 105'; 14" dia. screen interval 35'-96'

date test began 8/19/83 time test began 10:02 a.m.

water level indicator ___ Q = 3.2 gpm

TIME	DEPTH TO WATER (ft)	DRAWDOWN (residual) (ft)	ELAPSED TIME (min)	t/t'	REMARKS
9:40	52.25				
9:58	52.38				Before pump installed
10:01	52.18				pump installed
10:02	52.18				pump started
10:12	54.75		10.0		
10:22	56.21		20.0		1st 10 min dark discharge,
10:32	56.21		30.0		no odor
10:42	56.17		40.0		
10:52	56.10		50.0		
11:02	56.08		60.0		
11:12	56.08		70.0		
11:22	56.08		80.0		
11:32	56.10		90.0		
11:42	56.10		100.0		
11:52	56.10		110.0		
12:02	56.08		120.0		
12:12	56.08		130.0		
12:15	54.67		134.0		pump off for 45 sec
12:27	54.88		145.0		
12:37	54.90		155.0		
13:30	54.92		198.0		pump off
					1 gal. removed .633 gal
					casing volume: $\pi r^2 h$
					$\pi(0.6)^2(105-52.18) =$
					60 gal

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AQUIFER TESTING DATA

PROJECT NAME Edwards AFB — RECOVERY X
project # _____ well # 6E1 — PUMPING _____
location _____
formation tested _____ ground elevation _____ elevation of casing _____
distance from test well _____ depth of well _____ screen interval _____
date test began _____ time test began _____ $h_0 = 52.18'$
water level indicator _____

TIME	DEPTH TO WATER (ft)	$h_0 - h'$ DRAWDOWN (residual) (ft)	ELAPSED TIME (min)	$t/t' = \frac{t'+198}{t'}$	REMARKS
13:30	54.92		198		pump off
13:30:30	54.77	2.59	198.5	397	
13:31	54.25	2.07	199	199	
13:31:30	54.17	1.99	194.5	133	
13:32	53.92	1.74	200.0	100	
13:33	53.75	1.57	201.0	67	
13:34	53.50	1.32	202.0	50.5	
13:35	53.31	1.13	203.0	40.6	
13:36	53.0	0.82	204.0	34.0	
13:37	52.92	0.74	205.0	293	
13:38	52.85	0.67	206.0	25.8	
13:39	52.75	0.57	207.0	23.0	
13:40	52.63	0.45	208.0	20.8	
13:41	52.58	0.40	209.0	19	
13:42	52.52	0.34	210.0	17.5	
13:47	52.46	0.29	211.0	16.2	
13:52	52.42	0.24	216.0	12.0	
14:02	52.42	0.24	226.0	8.1	

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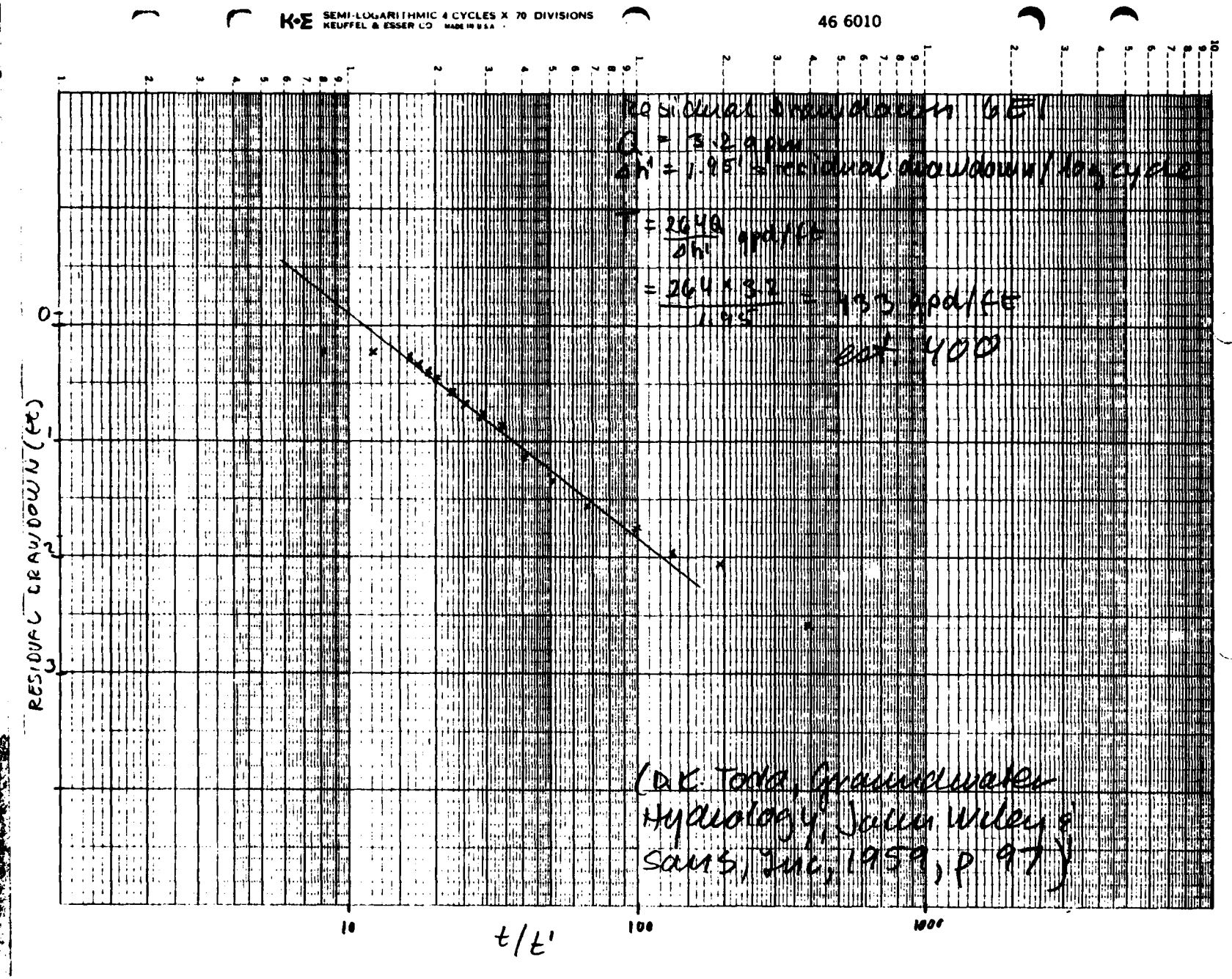
K•E SEMI-LOGARITHMIC 4 CYCLES X 70 DIVISIONS
KEUFFEL & ESSER CO MADE IN U.S.A.
46 6010
RESIDUAL DRAWDOWN (ft)
0
1
2
3
10
100
1000
t/t'
Residual drawdown plot
Q = 3.2 gpm
Δh' = 1.95' = residual drawdown / log cycle
T = 264Q/Δh' gpd/ft
= 264 × 3.2 / 1.95 = 433 gpd/ft
say 400
(D.K. Todd, Groundwater Hydrology, John Wiley & Sons, Inc, 1959, P 97)

APPENDIX E

ANALYTICAL RESULTS

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RESEARCH AND DEVELOPMENT LABORATORY
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Date Received 22 August 1983

LABORATORY ANALYSIS REPORT

Date Reported 26 October 1983

Job # 26339

For Edwards Airforce Base Attention: Yane Nordhav

Address

Lab No.	831082	831083	831084	831124
Source of Sample	Well 15 15' Soil	Well 15 30' Soil	Background Soil	Well 15 Water
Date Collected:				
Time Collected:				

Analyses	Units *	ANALYTICAL RESULTS			
Cadmium	ppm	0.65	0.21	0.30	<.01
Chromium	ppm	11.3	1.7	6.1	.05
Copper	ppm	6.7	0.95	3.6	<.04
Nickel	ppm	9.5	2.1	4.9	.15
Silver	ppm	4.9	2.9	2.2	.012
Zinc	ppm	22.8	7.4	25.9	<.04
Antimony	ppm	6.6	1.6	2.5	.032
Arsenic	ppm	60.7	0.92	0.21	.01
Lead	ppm	9.3	0.5	5.3	.035
Mercury	ppm	0.14	0.017	0.034	<.001
Selenium	ppm	9.7	1.0	6.4	.008

COMMENTS: *Dry weight basis

Method of analysis: Acid digestion followed by atomic absorption spectrophotometry (flame, graphite furnace, or cold vapor generation.)

Laboratory Manager

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Date Received 8-18-83

LABORATORY ANALYSIS REPORT

Date Reported 10-26-83

Job # 26339

For Edwards Airforce Base Attention: Yane Nordhav

Address

Lab No.	831086	831087	831088	831089
Source of Sample	Well 12 10' Soil	Well 12 20' Soil	Well 12 45' Soil	Well 12 55' Soil
Date Collected:				
Time Collected:				

Analyses	Units *	ANALYTICAL RESULTS			
Nitrate	ppm	0.77	0.20	0.19	0.30

COMMENTS: * Dry weight basis

Method of analysis: Aqueous extraction followed by automated cadmium reduction.

Laboratory Manager

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RESEARCH AND DEVELOPMENT LABORATORY
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Date Received 8-18-83

LABORATORY ANALYSIS REPORT

Date Reported 10-26-83

Job # 26339

For Edwards Airforce Base Attention: Yane Nordhav

Address

Lab No.	831090	831091	831279	
Source of Sample	Well 12 65' Soil	Well 12 103' Soil	Well 12 Water	
Date Collected:				
Time Collected:				

Analyses	Units *	ANALYTICAL RESULTS			
Nitrate	ppm	0.33	0.34	0.54	

COMMENTS: * Dry weight basis.

THESE RESULTS WERE OBTAINED BY FOLLOWING ACCEPTED LABORATORY PROCEDURES. THE LIABILITY OF THE CORPORATION SHALL NOT EXCEED THE AMOUNT PAID FOR THIS REPORT

Laboratory Manager

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Date Received

LABORATORY ANALYSIS REPORT

Date Reported 10-26-83

Job # 26339

For Edwards Airforce Base Attention: Yane Nordhav

Address

Lab No.	831092	831093	831094	831095
Source of Sample	Well 13 20' Soil	Well 13 30' Soil	Well 13 40' Soil	Well 13 45' Soil
Date Collected:				
Time Collected:				

Analyses	Units	ANALYTICAL RESULTS			
~~Fuels~~	ppm*	<100	<100	<100	4000

COMMENTS: *Wet weight basis. These results are only very rough estimates. Method of analysis: EPA Test Methods for Evaluating Solid Waste #8015 - non-halogenated volatile organics (by direct injection of a carbondisulfide extract.)

Kathy J. Ficklin
Laboratory Manager

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Date Received

LABORATORY ANALYSIS REPORT

Date Reported 10-26-83

Job # 26399

For Edwards Airforce Base Attention: Yane Nordhav

Address

Lab No.	831096	831097	831098	831099
Source of Sample	Well 13 50' Soil	Well 14 20' Soil	Well 14 30' Soil	Well 14 40' Soil
Date Collected:				
Time Collected:				

Analyses	Units	ANALYTICAL RESULTS			
~~Fuels~~	~~ppm~~ *	<100	<100	<100	<100

COMMENTS: * See pg. 4.

THESE RESULTS WERE OBTAINED BY FOLLOWING ACCEPTED LABORATORY PROCEDURES. THE LIABILITY OF THE CORPORATION SHALL NOT EXCEED THE AMOUNT PAID FOR THIS REPORT

Walter J. Ecklein
Laboratory Manager

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Date Received

LABORATORY ANALYSIS REPORT

Date Reported 10-26-83
Job # 26339

For Edwards Airforce Base Attention: Yane Nordhav

Address

Lab No.	831100	831101	831102	831103
Source of Sample	Well 14 45' Soil	Well 14 50' Soil	GF 1 Water	Well 13 Water
Date Collected:				
Time Collected:				

Analyses	Units	ANALYTICAL RESULTS			
Fuels	ppm*	300	<100	<20	<20

COMMENTS: * See pg. 4.

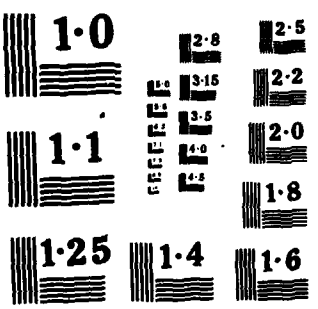
THESE RESULTS WERE OBTAINED BY FOLLOWING ACCEPTED LABORATORY PROCEDURES.
THE LIABILITY OF THE CORPORATION SHALL NOT EXCEED THE AMOUNT PAID FOR THIS REPORT

Laboratory Manager

AD-A157 702 INSTALLATION RESTORATION PROGRAM PHASE II STAGE 2 SURVEY EDWARDS AFB CALIFORNIA(U) ENGINEERING-SCIENCE INC ARCADIA CALIF AUG 84 F33615-80-D-4001

2/2

UNCLASSIFIED F/G 13/2 NL


1·0
1·1
1·25
1·4
1·6
2·8
3·15
3·5
4·0
4·5
2·5
2·2
2·0
1·8

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Date Received

LABORATORY ANALYSIS REPORT

Date Reported 10-26-83

Job # 26339

For Edwards Airforce Base Attention: Yane Nordhav

Address

Lab No.	831104	831119	831120	
Source of Sample	Well 14	MB-1	Well 13	
	Water	Water	Water	
Date Collected:				
Time Collected:				

Analyses	Units	ANALYTICAL RESULTS			
Fuels	ppm*	<20	<20	<20	

COMMENTS: *See pg 4.

THESE RESULTS WERE OBTAINED BY FOLLOWING ACCEPTED LABORATORY PROCEDURES. THE LIABILITY OF THE CORPORATION SHALL NOT EXCEED THE AMOUNT PAID FOR THIS REPORT.

Laboratory Manager

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Date Received

LABORATORY ANALYSIS REPORT

Date Reported 10-26-83

Job # 26339

For Edwards Airforce Base Attention: Yane Nordhav

Address

Lab No.	831085				
Source of Sample	Background Soil				
Date Collected:					
Time Collected:					

Analyses	Units *	ANALYTICAL RESULTS			
αBHC	ppb	<2			
βBHC	ppb	<2			
δBHC (Lindane)	ppb	<2			
BHC	ppb	<2			
Heptachlor	ppb	<2			
Heptachlor Epoxide	ppb	<2			
Aldrin	ppb	<2			
Dieldrin	ppb	<2			
Endrin	ppb	<5			
Endosulfun I	ppb	<2			
Endosulfun II	ppb	<5			
Endosulfun Sulfate	ppb	<10			
p,p' DDE	ppb	<2			
p,p' DDD	ppb	<5			
p,p' DDT	ppb	<5			
p,p' Methoxychlor	ppb	<10			

COMMENTS: Dry weight basis.

Method of analysis: EPA method 608 for pesticides and PCB's.

THESE RESULTS WERE OBTAINED BY FOLLOWING ACCEPTED LABORATORY PROCEDURES. THE LIABILITY OF THE CORPORATION SHALL NOT EXCEED THE AMOUNT PAID FOR THIS REPORT.

Laboratory Manager

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Date Received

LABORATORY ANALYSIS REPORT

Date Reported 10-26-83

Job # 26339

For Edwards Airforce Base Attention: Yane Nordhav

Address

Lab No.	831085				
Source of Sample	Background				
	Soil				
Date Collected:					
Time Collected:					

Analyses	Units	ANALYTICAL RESULTS			
Aroclor 1016	ppb	<10			
Aroclor 1248	ppb	<10			
Aroclor 1254	ppb	20			
Aroclor 1260	ppb	<10			
2,4-D	ppb	< 2			
2,4,5-TP (silver)	ppb	< 2			
2,4,5 T	ppb	< 2			

COMMENTS: *Dry weight basis.

Method of analysis: Herbicides - soxlet extraction followed by ASTM #509B for chlorinated phenoxyacid herbicides in water.

Hedv. J. Ecklin
Laboratory Manager

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Date Received _____

LABORATORY ANALYSIS REPORT

Date Reported 10-26-83

For Edwards Airforce Base Attention: Yane Nordhav

Address _____

Lab No.	831117	831118	831121	831122
Source of Sample	Well 12 10' Soil	Well 12 20' Soil	Bore 1 10' Soil	Bore 2 10' Soil
Date Collected:				
Time Collected:				

Analyses	Units *	ANALYTICAL RESULTS			
Chloroform	ppb	2.5	<2.5	<2.5	<2.5
Trichlorofluoromethane	ppb	<10	<10	<10	<10

COMMENTS: *Wet (as received) weight basis.
Method of analysis: EPA Method 601 for purgable halocarbons, modified to accept solid samples.

THESE RESULTS WERE OBTAINED BY FOLLOWING ACCEPTED LABORATORY PROCEDURES. THE LIABILITY OF THE CORPORATION SHALL NOT EXCEED THE AMOUNT PAID FOR THIS REPORT.

Andy L. Ficklin
Laboratory Manager

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Date Received

LABORATORY ANALYSIS REPORT

Date Reported 10-26-83

Job # 26339

For Edwards Airforce Base Attention: Yane Nordbay

Address

Lab No.	831123			
Source of Sample	Bore 3 10'			
	Soil			
Date Collected:				
Time Collected:				

Analyses	Units	ANALYTICAL RESULTS			
Chloroform	ppb*	<2.5			
Trichlorofluoromethane	ppb	<10			

COMMENTS: *Wet (as received) weight basis.

THESE RESULTS WERE OBTAINED BY FOLLOWING ACCEPTED LABORATORY PROCEDURES.
THE LIABILITY OF THE CORPORATION SHALL NOT EXCEED THE AMOUNT PAID FOR THIS REPORT.

Hedy Escalon
Laboratory Manager


DAT
FILM